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THE COLLECTING NET

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THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

DR. ERIC PONDER

The Biological Laboratory at Cold Spring Harbor, having struggled through the difficult years to a point where its future appeared rosy, suffered a terrible loss last January by the death of its Director, Dr. Reginald G. Harris. Scarcely a phase in its growth and in the development of its reputation was not due to him, and with his going we were left like a ship without a pilot. But a ship which has gone so far on its chartered course cannot be lightly abandoned, and so the Laboratory continues to do what it set out to do.

The principal activity during the summer will be the fourth Symposium on Quantitative Biology, this year on the subject of excitation phenomena. Most of the papers to be read and discussed during the first week are concerned with fundamental physico-chemical phenomena related to the excitatory state; then come, if not altogether in order, papers on the physical, chemical, and mathematical aspects of excitation in muscle and nerve, and (*Continued on page* 5)

M. B. L. Calendar

TUESDAY, July 7, 8:00 P. M.

Seminar: Dr. Alfred M. Lucas: Nerve cells without central processes in the fourth spinal ganglion of the frog.

Dr. José F. Nonidez: Receptor areas in the venae cavae and the pulmonary veins, and their relation to Bainbridge's reflex.

Dr. C. Ladd Prosser: Extinction of reflex responses in the rat.

Dr. R. W. Gerard: Factors influencing the electrical activity of the brain.

FRIDAY, July 10, 8:00 P. M.

Lecture: Prof. W. C. Allee, University of Chicago: Recent studies in mass physiology.

THE MARINE BIOLOGICAL LABORATORY IN 1935

DR. M. H. JACOBS

Attendance. Following the sharp decline in attendance in 1932 from the previous high figure of 362, the number of regularly registered investigators at the Laboratory has remained almost stationary, with only minor fluctuations from year to year. The exact figures for the past 5 years are: 362 in 1931, 314 in 1932, 319 in 1933, 323 in 1934 and 315 in 1935. The number of students in the courses has likewise remained practically constant at the limit set by the sizes of the available class-rooms. The total number of students and investigators together, after allowing for duplications, of 429 in 1935 represents approximately the optimum for the present facilities of the Laboratory since it is just sufficient to fill all the available space comfortably and without undue crowding. Particularly noteworthy in 1935 was the large number of institutions represented by investigators. Both this number, which was 111, and the total of 143 for investigators and students combined, were the largest in the history of the

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THE MARINE BIOLOGICAL LABORATORIES OF WOODS HOLE

Laboratory. The usual tabulation of the seasonal distribution of attendance at ten-day intervals for the past 9 years follows:

		1927	1928	1929	1930	1931	1932	1933	1934	1935
May	30	7	15	9	6	6	8	11	12	11
June	10	50	64	55	50	51	54	46	54	43
"	20	114	140	139	153	153	127	129	137	127
"	30	212	240	197	208	217	172	184	196	174
July	10	247	281	238	253	258	225	235	249	226
"	20	247	282	242	250	273	245	253	256	232
"	30	245	272	249	253	281	248	255	248	257
August	10	234	250	256	254	302	257	261	264	245
"	20	208	226	243	245	280	236	244	250	235
"	30	168	183	220	204	239	190	205	211	192
September	10	110	112	157	122	136	129	117	93	94
"	20	50	43	59	44	69	58	45	38	26
"	30	12	14	14	8	14	13	12	9	11

The Report of the Treasurer. In 1935, for the first time in four years, the annual decline in the income of the Laboratory from its endowment funds has been replaced by a slight increase. Though this increase amounted to slightly less than a thousand dollars, and though the total income from endowment of $47,950.76 is still nearly ten thousand dollars below that of pre-depression years, it is nevertheless very gratifying to be able to report an actual reversal of the previous trend. An inspection of Exhibit B from the Auditors' Report also reveals an increase of approximately $1,000.00 in the net income from the Supply Department (though the gross receipts were less than those for 1934), and similarly, for the first time in 4 years, there has been a slight but encouraging increase in the receipts from the rental of research space. Particularly helpful to the Laboratory at a time when its regular income was at nearly its lowest level since the establishment of its present endowment fund was a second special dividend from the General Biological Supply House, this dividend representing profits accumulated but not distributed during a period when business uncertainties made a relatively large reserve seem desirable.

Though in view of all the circumstances the present financial situation of the Laboratory is very satisfactory, it should nevertheless be noted that the annual gross income in 1935 was nearly forty thousand dollars less than that in 1931 and that throughout the period of the depression the budget has been kept balanced only by drastic economies of various sorts, some of which cannot much longer be continued without detriment to the scientific activities of the institution. It should likewise be remembered that for a considerable number of years to come the income of the Laboratory will be adversely affected by the

CAPTION OF AERIAL PHOTOGRAPH ON ADJACENT PAGE

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The Apartment (25-108)
The Old Lecture Hall (25-113)
The Old Main Building (28-115)
The Botany Building (28-114)
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The M. B. L. Wharf (29-135)
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THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

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gradual maturing of securities in its endowment fund, the proceeds from which must of necessity be reinvested at lower rates of interest. While the financial position of the Laboratory is therefore sound, and indeed extremely fortunate as compared with that of most other scientific and educational institutions, it is not at present such as to justify any departure from the very conservative policy with regard to expenditures that has been followed for the past four years.

The Report of the Librarian. Though it has not yet become possible to restore the earlier rate of growth of the library, temporarily checked by the reduction in the income from endowment funds, it is nevertheless encouraging to record very satisfactory gains during the past year. In particular, the increase in the number of journals currently received, amounting to 74 for the year in question, has been the largest for any single year since 1931. Substantial progress in the completion of back sets of journals has also been made. As the number of reprints in the library approaches the 100,000 mark, the attention of all members of the Corporation is invited to the desirability of transferring to this collection reprints in their own possession which are little or not at all used, but which might be of great value to other workers at the Laboratory.

Lectures and Scientific Meetings. The number of general lectures was 11, while there were also held 8 evening meetings and an all-day scientific session devoted to work accomplished at the Laboratory during 1935, at which 67 shorter papers were presented and discussed. Abstracts of most of these shorter papers, which cover a wide range of scientific activities, will be found in the *Biological Bulletin* for October, 1935.

Apparatus Committee. The great diversity in the character of the investigations carried on at the Marine Biological Laboratory and particularly the increasing complexity of the apparatus needed for their successful prosecution has for some time rendered desirable an advisory body, analogous to the Library Committee, the members of which can give advice concerning the purchase of special types of equipment of whose use they have expert knowledge, and who in cooperation with the Technical Manager can determine questions of general policy with regard to the most effective use of the valuable apparatus already in the possession of the Laboratory. To meet this need, following authorization by the Executive Committee, President Lillie in the early summer of 1935 appointed a Committee of three consisting of Drs. Garrey, Harvey and Heilbrunn, which was later enlarged to the following membership: Drs. W. R. Amberson, D. J. Edwards, W. E. Garrey, E. N. Harvey, M. H. Jacobs and L. V. Heilbrunn, Chairman. During the summer of 1935 extremely useful work was accomplished by the original committee of three in making a general survey of all the apparatus belonging to the Laboratory and in securing from individual investigators a large number of valuable suggestions. At a meeting of the full committee held in September a series of general recommendations based on the information so obtained was drawn up. These recommendations should serve as a very sound basis for the future policies of the Laboratory in this important and highly technical field.

Board of Trustees. At the meeting of the Corporation held on Tuesday, August 13, 1935 the long and valuable services on the Board of Trustees of Professor G. H. Parker, whose membership began in 1908, and of Professor W. M. Wheeler, whose membership began in 1919, received recognition by the election of both to the permanent position of Trustee Emeritus. To fill the vacancies thus created the Corporation elected Professor C. E. McClung (Class of 1936) and Dr. A. H. Sturtevant (Class of 1939) respectively. Professor Laurence Irving was also chosen to succeed Professor W. C. Curtis as a member of the Class of 1939.

THE GROWTH OF THE LIBRARY SINCE 1925

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Serials received currently	500	628	764	874	985	1,060	1,080	1,126	1,137	1,197	1,271
Total number of bound volumes	15,000	18,200	22,800	26,500	28,300	31,500	33,800	36,000	37,400	38,600	40,200
Reprints	25,000	38,000	43,000	51,000	59,000	64,000	70,000	76,000	81,000	86,000	92,000

NOTE: This report of the Director is a section of the "Thirty-eighth Report" of the Marine Biological Laboratory which will be published in the August issue of "The Biological Bulletin."

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(Continued from page one)

these are followed by papers on somewhat more specialized subjects, such as the effects of pressure and the properties of the synapse. Most of the last week is devoted to the consideration of cerebral potentials, and a glance at the program will show that this Symposium will be one of unusual physiological interest.

PROGRAM

Tuesday, June 23

GEORGE S. DE RÉNYI: Morphological Basis of Nervous Action.

Wednesday, June 24

F. O. SCHMITT: X-ray Diffraction in Nerve.

Thursday, June 25

DUNCAN MACINNES and L. G. LONGSWORTH: The Potentials of Galvanic Cells with Liquid Junctions.

L. R. BLINKS: Potential and Current Flow Studies in Valonia, Halicystis, and Nitella.

Friday, June 26

THEODORE SHEDLOVSKY: Distribution of Electlytes between Non-miscible Solvents.

KATHERINE B. BLODGETT: Demonstration of Methods for the Study of Interfacial Phenomena.

Saturday, June 27

W. J. V. OSTERHOUT: Some Ways to Control Bioelectrical Behavior.

Wednesday, July 1

H. A. BLAIR: The Kinetics of the Excitatory Process.

Thursday, July 2

KENNETH S. COLE: Impedence Measurements on Nerve.

EMIL BOZLER: The Change of Conductivity of Tissues during Activity.

Friday, July 3

LOUIS LAPIQUE: Connection between Subordination-Chronaxie and Reflex Excitability.

A. M. MONNIER: Physical and Chemical Aspects of Neuromuscular Transmission.

Monday, July 6

F. O. SCHMITT: Nerve Metabolism.

Tuesday, July 7

WILLIAM R. AMBERSON: The Mechanism of Production of Membrane Potentials.

C. C. SPEIDEL: Experimental Induction of Visible Structural Changes in Single Nerve Fibres in Living Frog Tadpoles.

Wednesday, July 8

ALEXANDER FORBES: Conduction in Axon and Synapse.

GEORGES COPPEÉ: Stimulation by Alternating Currents.

Thursday, July 9

DETLEV W. BRONK: The Activity of Nerve Cells.

ARTURO ROSENBLUETH: Neuromuscular Transmission in Somatic and Autonomic Systems.

Friday, July 10

MCKEEN CATTELL: On the Significance of the Initial Heat and Its Application to the Measurement of Muscular Efficiency.

HARRY GRUNDFEST: Excitation and Recovery in Nerve as Modified by High Pressure.

Monday, July 13

W. O. FENN: Isotonic Contractions in Muscle.

DUGALD BROWN: The Sequence of Events in the Contraction of Muscle at High Pressures.

Wednesday, July 15

G. KATO: On the Excitation, Conduction, and Narcotisation of Single Nerve Fibres.

Thursday, July 16

W. O. FENN: The Electrolyte Equilibrium in Muscle.

R. W. GERARD: On the Metabolism of Nerve Cells.

Friday, July 17

HUDSON HOAGLAND: Some Pacemaker Aspects of Rhythmic Activity in the Nervous System.

ERNST FISCHER: The Submicroscopic Structure of Muscle and Its Changes during Contraction and Stretch.

Saturday, July 18

N. RASHEVSKY: Physico-mathematical Aspects of Excitation and Conduction in Nerves.

Monday, July 20

HALLOWELL DAVIS: Some Aspects of the Electrical Activity of the Cerebral Cortex.

R. W. GERARD: Factors Controlling the Nervous Activity of Neurones.

Tuesday, July 21

G. H. BISHOP: The Interpretation of Cerebral Potentials.

Wednesday, July 22

HERBERT H. JASPER: Cortical Excitatory State and Synchronism in the Control of Bioelectric Autonomous Rhythms.

Thursday, July 23

C. LADD PROSSER: Rhythmic Activity in Isolated Nerve Centres.

Friday, July 24

HUDSON HOAGLAND: On the Mechanism of Adaptation (Peripheral Sensory Inhibition) of Mechanoreceptors.

As in past years, the reading of each paper will be followed by discussion of it by the group present, and, in order to give others an opportunity to take part, proof of many of the papers is being sent to scientists, both in this country and abroad, who are unable to attend personally. Anyone, indeed, who feels that he has something to contribute to the discussion of any of the subjects dealt with can get a copy of the proof of any paper by writing to the Laboratory, and can send his comments by mail to be read when the paper is formally discussed. This method of dealing with the more controversial points has worked well in the past, and this year's Symposium is conspicuous for the number of contributors who will be actually in residence at the Laboratory, some for the entire time, and some for shorter periods; the result ought to be that the topics to be dealt with will be dealt with very completely.

It always takes some time for the results of any new venture to become apparent, but the value of these annual Symposia is being most clearly shown this year by the increased amount of independent research which is to be carried out at the Laboratory. Dr. Kenneth Cole, Dr. H. J. Curtis, Dr. Theo. Jahn, and their assistants, plan to work throughout the summer on the impedance of muscle, nerve, and various sorts of membrane, and another research team, consisting of Dr. Jasper, Dr. Andrews, Dr. Rheinberger, and Dr. Solomon is expected to be working on cerebral potentials during the Symposium period. Dr. Abramson and Dr. Moyer are going to continue their research on electrophoretic phenomena, as well as their teaching in the General Physiology course, and we expect Dr. Rudolph Katz during July and August to carry out investigations on the x-ray diffraction patterns of muscle. Dr. J. Z. Young, visiting from England, intends to continue his investigations on the giant nerve fibres, some of which are as much as 1 mm. in diameter, found in the cuttle-fish and squids, and we hope to have at the Laboratory, Professor F. O. Schmitt, to study these giant fibres with the polarising microscope, as well as to take part in the Symposium. Dr. A. A. Schaeffer is continuing his work on spiral movement, Dr. T. L. Smith his work on the genetics of *Galleria mellonella,* Dr. Samuel Morris his investigations of parasites of Limulus, and Dr. Bert Cunningham his measurements of the water exchange in the eggs of the turtle. This list of investigators is not numerically so imposing as that which would proceed from a larger laboratory, but is enough to tax our existing space to the limit, particularly when it is remembered that it is a seasonal addition to the all-year research in biophysics and physiology.

The other summer work at the Laboratory remains much as it was in 1935. The number of students is about the same (30 to 35), and is as great as we can comfortably accommodate. Dr. George W. Corner, of the University of Rochester School of Medicine and Dentistry, is again in charge of the course in Surgical Methods, and is assisted by Dr. E. W. Blanchard. There seems to be great demand for this course, not only among graduate students, but among faculty members from various universities, and the large number of applications received has enabled us to hand-pick the students. The course in General Physiology is again in the charge of Dr. I. R. Taylor of Brown University, and is being given on the same plan as last year, with lectures by Symposium members and visitors as well as by the staff, and with Drs. Abramson, Cole, Fricke, and Moyer taking charge of special phases of the work. In the second part of the summer the course in Marine and Fresh Water Zoology will be given by Drs. Spieth, Castle, and Van Cleave, and the course in Plant Sociology will be in the charge of Dr. Stanley Cain, as heretofore.

I realize that the foregoing is more of a "news note" than a "report" such as The Collecting Net usually publishes in its first issue each year. This, however, is scarcely the time to write about the future; it is enough to quote from the Annual Announcement: "The sudden death of Director Harris on January 7, 1936, in the midst of his rapidly expanding program for the Laboratory, has left the Board of Directors of the Association shocked but entirely resolved to carry on that program."

THE EMBRYOLOGY COURSE

Dr. Charles Packard

Assistant Professor of Zoology, Columbia University Institute for Cancer Research

The essential feature of the Embryology Course, which distinguishes it from the usual courses offered in college, is the opportunity to watch the development of various eggs from the moment of fertilization until they become complex organisms. The subject ceases to be a study of separate stages: it becomes a study of continuous, vital processes. The forms used in the laboratory illustrate the phenomena of the entrance of the sperm into the egg, maturation, various types of cleavage, of gastrulation, and the formation of the embryo and larva. Some can be carried through to almost the adult condition. The course is a valuable background for the teaching and the experimental biologist.

The experimental phase of embryology is emphasized throughout, both in the laboratory and the lectures. Each week some investigator, not connected with the course, presents the results of his work. The students are encouraged to undertake problems. Those who make good progress in their investigation have the opportunity of continuing after the formal ending of the course.

THE MT. DESERT ISLAND BIOLOGICAL LABORATORY

Dr. William H. Cole, *Director*
Professor of Physiology and Biochemistry, Rutgers University

In 1898, Dr. J. S. Kingsley of Tufts College opened the Harpswell Laboratory at South Harpswell, Maine, for biological study and investigation. Although the location and name of the laboratory have changed since then, there has been no interruption of biological investigation. In 1921 the laboratory was moved to Salsbury Cove, Maine, on Mt. Desert Island, and the name was changed to the Mt. Desert Island Biological Laboratory. It is incorporated, and has at present a membership of fifty-six.

The present location of the laboratory allows easy access to the unusually rich collection of animals and plants of the Gulf of Maine, which are typical of the Acadian fauna extending from Newfoundland to the northern shore of Cape Cod. A tide averaging twelve feet, and many different types of bottoms, coves and bays provide unusual collecting opportunities. Among the animals easily obtainable, besides the commoner species found elsewhere, are: Cyanea, *Cerebratulatus lacteus,* Echiurus, Terebratulina, *Pecten maximus,* Acmaea, Echinarachnius (sexually mature from June to October), Crossaster, Holaster, Cynthia, Boltenia and many other genera of hydrozoa, nemerteans, annelids, molluscs and crustacea. The marine fishes, Myxine, Petromyzon, dogfish, skates and numerous others are also abundant.

The annual Bulletin is published in January, and contains abstracts of research accomplished during the previous summer. Copies are available upon request to the Director.

During the past two summers, an exploratory study of the structure and physiological activities of the hypophysis of marine animals has been under way. Preliminary studies indicated that the gland of the dogfish and skate affords particularly favorable material for investigation of the different types of hypophyseal gland cells and their secretions. Last summer six workers cooperated in morphological, physiological, and pharmacological studies. It was shown that the gland is composed of six lobes, each one easily separable from the others. The intermediate lobe, which is lacking in certain animals or is small and closely associated with neighboring lobes in other animals, is the largest lobe of the gland in the cartilaginous fishes, and can be easily separated from the other tissues. Cytological studies indicate that each lobe is composed of glandular tissue made up of cells characteristic for it. In other words, there is a segregation of a special sort of cell in each lobe, instead of an intermingling as among the cells of the mammalian gland. This segregation of special cells in the lobes and their tissue culture offers an unusual opportunity for the isolation of the various active principles or hormones, for the determination of the cells from which they are derived and for the determination of the effects produced by each hormone. Operations for the removal of part or of the whole of the gland from living dogfish have been carried out successfully, so that future experiments on such operated animals seem assured.

A partial list of investigators and their subjects of study for the current season is as follows: Dr. and Mrs. Warren H. Lewis, Carnegie Institution, "Tissue cultures of the dogfish hypophysis and of cancerous tissues"; Dr. Earl O. Butcher, Hamilton College, "The histology and cytology of the dogfish hypophysis and the effects of its secretion on the reproductive system"; Dr. Robert W. Clarke, New York University, "The development of operative procedures and the interrelationships between the gland and the kidney"; Dr. J. T. Halsey, Tulane University, "Effects of the gland's secretions on the circulatory system"; Dr. William H. Cole, Rutgers University, "The effect of the gland's secretions on the pigmentation of the skin and on ciliary activities"; Dr. D. E. Minnich, University of Minnesota, "The behavior of certain annelids and crustacea"; Dr. George B. Roth, George Washington University, "Pharmacological studies on the circulatory system"; Dr. Ulric Dahlgren and assistants, Princeton University, "Survey of the marine invertebrates of the Mt. Desert region"; Mr. Samuel S. Miles, Princeton University, "Studies on the hydroid, Primarius"; Mr. E. L. Young, III, Harvard University, "The wasting disease of eelgrass"; Dr. Vera Koehring, Deaconess Hospital, Boston, Mass., "The heart beat of molluscs"; Dr. A. A. Boyden, Rutgers University, "Phylogenetic relationships as measured by the precipitin test."

The laboratory is open each summer from June 15th to Sept. 15th. All inquiries should be addressed to the Director, Prof. William H. Cole (from Sept. 15th to June 10th: Rutgers University, New Brunswick, N. J.).

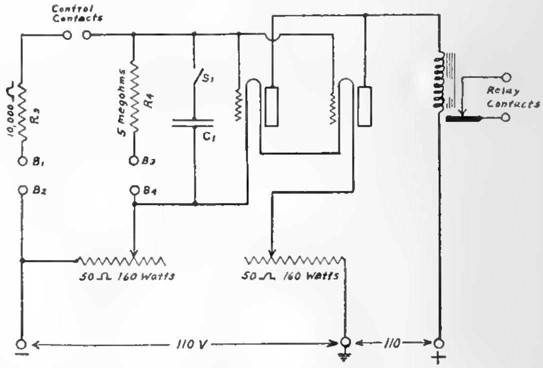
THE ELECTRON TUBE RELAY

Dr. Kenneth C. Fisher
Demonstrator in Biology, University of Toronto

Many of the control or signalling devices which are most useful in the laboratory are "relays" in which a comparatively large amount of power is controlled by a relatively much smaller amount. These are most satisfactorily operated electrically and are therefore applicable whenever the operation in question can be arranged to open or close an electrical contact. In general it is desired that such an appartus operate on the least possible current and at the same time control the greatest current likely to be encountered. Of late years electron tubes of many varieties have been developed which, when combined with the necessary accessory equipment, are peculiarly and in certain cases specifically adapted to such service. Several of the possible arrangements embodying these have been given a more or less extended trial in the laboratory for experimental biology at Toronto and as a result one of them has particularly commended itself by virtue of its general utility and its adaptability to a rather wide range of applications. Though not in any sense new, the possibilities of the apparatus do not appear to have been made sufficiently clear to biologists and since it is likely that this versatile device will become an increasingly important tool to those concerned with the experimental phases of biology, a description is presented herewith together with an outline of services it now performs routinely in our laboratory.

The diagram below shows the electron tube relay complete as we have set it up but without switching arrangements, pilot lamps, and so on. It can be assembled in "breadboard" style for \$10-\$15 and can be mounted in a metal case and the switching refinements added for another \$5 exclusive of labor, \$20 in all. So far as the writer is aware, only one of the usual scientific supply houses lists such an instrument, and its cost is more than double this. The design characteristics indicated here were for operation on the three wire 220 volt D. C. system of the laboratory. For use on any other power supply, such as lower voltage D. C. or A. C., slight changes in the circuit are necessary. These do not alter the fundamental operation of the unit, and they would not increase the cost by more than \$5.

As the circuit indicates, the electron tube relay is a combination of an ordinary electric relay and an electron or vacuum tube. The relay found to be quite suitable is the single pole contactor (contacts normally open) type CR2810-1265G for 96 volts D. C. made by General Electric, while



the tube used is a common type made for radio receivers, the '45 (two tubes are used in parallel to reduce resistance). On first setting up the components R_1 and R_2 are adjusted to give the largest possible plate current change on opening and closing the control contacts at the same time maintaining the filament current at its rated value. The switching abilities of the combination depend on the fact, that when the grid of the tube is negative with respect to the cathode, electrons do not pass from this electrode to the plate; there is thus no current through the relay winding and springs keep the contacts open. However, if the grid is allowed to come to the same potential or nearly the same potential as the cathode, then electrons pass over to the plate, current flows through the relay energizing it and consequently the contacts are closed. The current made and broken at the control contacts is of the order of 10 microamperes, while the current controlled by the relay specified may be 15 amperes, a current amplification for control purposes of over one million times. As will be described later, the instrument can be adjusted to operate on much less current even than 10 microamperes when conditions make this desirable.

For many relay requirements, time delay elements are necessary. This characteristic, within limits, is very simply obtained in the electron tube relay by the inclusion of a condenser (C_1) in the grid circuit. The various types of control possible are obtained by changing certain connections in the grid circuit. These are tabulated here and will be referred to by number.

On making control contacts the relay: (1) immediately opens for connections S_1 open, B_1 and B_2 connected, B_3 and B_4 connected; (2) immediately closes for *c's*. S_1 open, B_1 and B_4 con-

nected, B_2 and B_3 connected; (3) opens after a slight delay (approximately 0.1 second) for *c's*. $R_3 = 0.5$ meg., $C_1 = 0.2$ mfd., S_1 closed, B_1 and B_2 connected, B_3 and B_4 connected; (4) closes after a slight delay for *c's*. $R_3 = 0.5$ meg., $C_1 = 0.2$ mfd., S_1 closed, B_1 and B_4 connected, B_2 and B_3 connected; (5) immediately opens for *c's*. S_1 open, B_3 and B_4 unconnected, B_1 and B_2 connected.

On making but then immediately breaking the control contacts the relay: (6) momentarily opens for *c's* as in (1) above; (7) momentarily closes for *c's* as in (2) above; (8) opens, but after approximately 10 seconds closes (time set by R_4 and C.) for *c's*. S_1 closed, $C_1 = 2.0$ mfd., B_1 and B_2 connected, B_3 and B_4 connected; (9) closes, but after approximately 10 seconds opens for *c's*. S_1 closed, $C_1 = 2.0$ mfd., B_1 and B_4 connected, B_2 and B_3 connected. *c's* = connections.

The most common use of the vacuum tube relay in the laboratory is in the control of thermostats by means of the familiar types of thermoregulator which close a contact as the bath heats up. This use calls for set-up number one. Because of the low current drawn and the high resistance through which the control contacts may be satisfactorily closed, the efficiency of thermoregulators is increased, and they require very little attention. The function of the circuit may be altered from on-off to off-on by shifting the connections to number two, so that, for example, a refrigerating device may be turned on as the bath becomes too warm. Where the control contacts are unavoidably subject to mechanical vibration, the relay chattering which would otherwise be inevitable may be greatly reduced by linking with number one or two a slight delay characteristic, so that the relay operates only after the control circuit has been made or broken for an appreciable period of time (schema three and four).

Since the control contacts may be closed through as high a resistance as 500,000 ohms with satisfactory operation, either connection six or seven enables the instrument to be used as a drop recorder, the drops being caused to fall between two control contacts. For this purpose, each drop is signalled somewhat more positively if in addition S_1 is closed and C_1 made about 0.02 microfarads.

The contacts on the clocks used to provide time signals in the laboratory are usually not capable of handling much current, and, as a result, frequently requiring cleaning. This is particularly true when the time signals are wired to an entire class. The inconvenience of burned contacts is effectively eliminated if the clock first activates an electron tube relay which in turn controls the signalling circuit.

Certain experiments proceeding in our laboratory required that an electrically driven kymograph be run for ten seconds out of each minute. This was accomplished automatically by means of the clock and a tube relay with connection schema nine. Each minute the clock momentarily closes the control contacts. This closes the relay which then starts the kymograph motor. Ten seconds or so later the relay opens, and it stops.

This tube relay is proving of considerable value both experimentally and clinically in controlling slow perfusions; for if the perfusion fluid be passed as drops between the control contacts, then the perfusion rate may be estimated from the drop frequency, or if schema eight be employed, so long as the drops come fast enough, the relay will remain closed. When the drop frequency becomes slower than once every ten seconds approximately, the relay will close for a period after each drop and, therefore, signals that the perfusion rate has slowed. The exact frequency at which this occurs (over the range from about 3 or 4 per second to 1 per 10 seconds) can be made variable by making R_4 adjustable. Changes of frequency of about 20% are sufficient to start the relay signalling.

It should be pointed out that the instantaneous current across the control contacts, when large condensers are being used in the grid circuit, is, of course, much greater than the 10 microamperes mentioned earlier, though the average current is not appreciably altered.

Special circumstances may require that the relay unit be activated through resistances greater than 500,000 ohms. This we had occasion to do in devising a mechanism to supply 99.8% alcohol to the alcohol test flame in a closed circuit calorimeter. To maintain a constant head of pressure at the alcohol supply, the control contacts of the relay device were closed through a column of the alcohol. Connection schema five permits operation through such an extremely high resistance. The very low current which is sufficient in this case entails excellent insulation of all wires in the grid circuit; otherwise current leaks occur which effectively close the control contacts rendering the outfit inoperative.

One possible objection to these relay units is the tube life which on the average amounts to only 1000 hours, the equivalent of some 40 days of continuous use. For long period operation, it would be advisable to replace the type '45's with some one of the tubes developed for commercial purposes where the tube life may be ten times this figure.

We would be glad to hear of the experiences of any others who have used this type of instrument and to communicate with any who might like further details concerning the units we have constructed.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt, Annaleida Snyder Cattell and Francis McInnis.

Business: Arthur C. Stirling, Amy Gamble and Boris Gorokhoff.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

THE FUNCTION OF THE COLLECTING NET

The Collecting Net is an independent journal devoted to marine biological laboratories; no institution or society controls its policies. Its editorial content reflects the wishes of our subscribers in so far as we can ascertain them.

One of the most useful functions of the journal is to serve as a medium for the discussion of problems on which there is a difference of opinion. The very question, itself, is open to debate for some individuals at Woods Hole strongly feel that the journal should be devoted entirely to reporting the results of research work in the biological sciences.

We have always thought that The Collecting Net should treat of matters pertaining to the biologist as a member of society as well as a worker in biology. In general we have not encouraged discussion of the general organization and policies of marine laboratories. For example, a few years ago there was active discussion as to whether the Marine Biological Laboratory should continue to train students in biology or devote itself entirely to providing facilities for research work; the journal printed nothing concerning this matter.

Possible topics for discussion are:

Should marine biological laboratories concern themselves officially with recreational facilities for its workers? Should they assist financially in providing opportunities for social intercourse, for tennis and for bathing?

Might it not be desirable for some of the larger marine biological laboratories to include on their board of trustees the directors of their sister institutions?

Should The Collecting Net encourage discussion of matters such as those given as examples above? ☐ yes ☐ no

Should The Collecting Net conduct an editorial page analogous to those in certain other scientific magazines such as the *Journal of Engineering and Industrial Chemistry*, the *Journal of the American Medical Association* and *Nature*? ☐ yes ☐ no

Name

Might it be feasible to arrange between marine biological laboratories a kind of "exchange professorship;" that is an exchange of investigators so that they would be provided with complimentary research facilities?

Should expensive apparatus be duplicated in several laboratories, or should there be some coordinating committee which would guide the development of the several institutions so that as a whole they would be as useful as possible in promoting biological research?

Should they formally adopt The Collecting Net as their official organ?

Might each laboratory appoint a committee which would assist the journal in better serving the interests of marine biological laboratories?

Might each laboratory appoint a committee to assist The Collecting Net Scholarship Fund Association in raising money which would be apportioned among the different laboratories in accordance with the number of investigators workign at each?

We take the liberty of seeking the advice of the readers of The Collecting Net. We shall appreciate it if they will answer the questions on the "coupon" at the bottom of the adjacent column.

SCHOLARSHIPS FOR 1937

Since its formation in 1926 The Collecting Net has awarded over $4,000 in the form of scholarships to young investigators in the biological sciences. In order to insure their permanency an organization to be known as The Collecting Net Scholarship Fund Association is in the process of formation. Certain prominent individuals have consented to serve on its Board of Trustees; their names will be announced next week.

The annual membership fee will be $5.00; other classes of membership will be provided for individuals who care to make a larger contribution. Members will receive not less than four bulletins a year reporting upon the condition of the Fund and the work carried out with its assistance. So that membership fees can be applied in full to scholarships The Collecting Net will undertake to finance the entire cost of administration.

BATHING BEACHES

The Bay Shore bathing beach is in poor condition this year; people who have cars swim at the Nobska Beach a mile away, but many must use the rocky beach on the Bay Shore or forgo their between-work-and-supper swim. Some believe that it is within the province of the laboratories at Woods Hole to take the initiative in improving the situation. The Marine Biological Laboratory contributes directly or indirectly to the support of the M. B. L. social and tennis clubs, yet more biologists "sun and swim" than visit the clubhouse or the tennis courts.

ITEMS OF INTEREST

PROFESSOR CONKLIN'S TRIP TO EUROPE

Dr. Edwin G. Conklin, emeritus professor of biology at Princeton University and trustee of the Marine Biological Laboratory, and Mrs. Conklin, sailed for Plymouth, England, aboard the *SS Vollendam* on June 24.

Dr. Conkin's first attended the centenary celebration of the University of London. In the latter part of this month he will be a delegate to the Second International Congress for Microbiology at University College, London. From August 10-15 he will be present at the Fourth International Congress for Experimental Cytology which will meet in Copenhagen. Edinburgh will be Professor Conklin's next stop where he will attend the International Congress of Geophysics and Oceanography. He will end his attendance at conferences with the one hundred and fifth annual meeting of the British Association for the Advancement of Science which convenes during the second week in September.

Dr. Conklin is chairman of a committee of the American Philosophical Society which well supervise the spending of the income from the very large Penrose bequest; therefore he will devote much of his time abroad studying the methods of the Royal Society in assigning grants-in-aid for promoting scientific work.

From his fellow trustees and associates at Woods Hole, Professor Conklin received the following telegram on the boat. "Advantages and disadvantages go together. You will have the former, we, without you, will have the latter. We are going to miss you. Your genial presence and wise counsel do much to make Woods Hole summers pleasant and profitable. We go with you in spirit enjoying what you do knowing that in time we shall get it anyway from you, and we shall be all the more happy to get you back again. Our best wishes go with you and may you get a big return on your venture. All who are registered at the M. B. L. would be glad to subscribe to this wish which a few of us sign asrepresentatives of all. Good luck to you and to Mrs. Conklin."

Dr. Conklin wired this reply: "Please express to all signers of the delightful message of friendship and best wishes which we have just received the gratitude and thanks of Mrs. Conklin and myself."

DR. RALPH S. LILLIE, professor of physiology and zoology at the University of Chicago and trustee of the Marine Biological Laboratory, received the honorary degree of Doctor of Science at the June convocation of the University of Toronto.

DR. REDFIELD'S EVENING LECTURE

On Friday, June 26, the first evening lecture of the season was given by Dr. Alfred C. Redfield, professor of biology at Harvard University and physiologist at the Woods Hole Oceanographic Institution. The speaker was introduced by Dr. Frank R. Lillie, president of the Corporation of the Marine Biological Laboratory and dean of the division of biological sciences at the University of Chicago.

Dr. Redfield's subject was the "Ecological Significance of the Gulf of Maine" prepared from observations in the Gulf of Maine area which covered a period of two years. Dr. Redfield discussed his findings in some detail, but the conclusions that he made are as follows: The animal life in the sea follows a circular path around the Gulf, coming in at the north and circulating around in an anti-clockwise direction, and that it seems to follow in the wake of a body of water of a fairly constant temperature and salinity introduced north of George's Bank during the winter. He indicated that the animal life in the Gulf is related to this yearly flow of water. As an aside, Dr. Redfield cited a few observations that he made of birds in that region as indicators of abundant animal plankton. The greatest number of birds seems to follow fairly closely in a cycle similar to the life in the water.

Charts and graphs which gave results of his tabulations in the various sections of waters showed the relationship of temperature, birds, and animal life; they also showed that these conditions followed the current through its circular course.

DR. ERIC G. BALL will be in charge of the Chemical Room while Dr. Oscar W. Richards is at the Tortugas Laboratory studying the growth and development of the ascidian *Phallusia nigra*. Dr. Richards who sails today will return to Woods Hole on August 25.

DR. WALTER E. GARREY, professor of physiology, Vanderbilt Medical School, Nashville, Tenn., was rushed to the Baker Memorial Hospital in Boston on June 2 with a severe attack of kidney stones. Dr. Garrey recuperated rapidly and returned to Woods Hole several days ago.

DR. FELIX A. BERNSTEIN, formerly director of the Institute of Mathematical Statistics and professor at the University of Goettingen in Germany, has been appointed professor of biometrics at New York University. Dr. Bernstein is spending the summer at Woods Hole doing research work with the assistance of his daughter, Marianne, of Barnard College.

THE WOODS HOLE MEETING OF THE GENETICS SOCIETY OF AMERICA

This year's meeting, scheduled for Friday and Saturday, September 4 and 5, is timed to come just before the biological program of the Harvard Tercentenary Conference so as to make it possible for members to attend both.

The program will consist of two round table conferences and one session of demonstration papers. In addition, a regular Marine Biological Laboratory lecture will be given Thursday evening. Brief formal papers will not be presented. The round table conferences will consist of general discussions dealing with problems of broad interest. Each conference will be in charge of a leader, and the subject will be introduced by the short presentations of two introducers. One demonstration session will be available for informal presentation and discussion of current problems. Whenever feasible, charts, specimens, and other exhibit material will be used in connection with demonstration papers. A limited number of microscopes have been made available for demonstration purposes.

The Marine Biological Laboratory is offering the Society its facilities for meeting purposes. Rooms are available in private houses for approximately \$1.00 to \$1.50 per day per person or at special rates per week. There should be plenty of rooms early in September. Past experience indicates that it is not always successful to make a room reservation ahead of time. Signs on the doors of the houses advertise available places, and members may select their own rooms upon arrival.

Abstracts of demonstration papers (up to 250 words) should be in the hands of the Secretary not later than August 15. These abstracts will be available in mimeographed form at the time of the meeting and they will be published in the Records in December. The full program will be published in an early issue of THE COLLECTING NET. —M. D.

The *Atlantis*, research vessel of the Woods Hole Oceanographic Institution, returned to Woods Hole last Monday after a three weeks' trip. The object of the trip was a hydrographic survey of the slope water between the north edge of the Gulf Stream and the continental shelf. The tests were conducted in the waters between the east side of Georges Banks and the tail of the Grand Banks. This was the third of a series of four cruises which will cover one year's observations. Columbus Iselin, physical oceanographer, was in charge of the scientific work of the trip.

FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

DR. E. W. BLANCHARD is here to assist Dr. Corner in the course in surgical methods in experimental biology. Mrs. Blanchard will join him later in the summer for a week or two.

DR. DAVID R. CLIMENKO has been doing research here for the Calco Chemical Company during the winter and will continue during the summer.

DR. KENNETH S. COLE and MRS. COLE will be here all summer. Dr. Howard J. Curtis, Dr. Cole's research associate, and Mrs. Curtis also plan to spend the summer here. Drs. Cole and Curtis will teach in the course in general physiology as well as continue their research.

DR. GEORGE W. CORNER will be in residence until the end of July, to direct the class in Surgical Methods. Miss Hester Ann Corner will be here for the same time, and Mrs. Corner will visit for a part of July.

DR. HUGO FRICKE will spend his three months leave of absence in Europe.

DR. LAURENCE MOYER has been appointed an assistant in the course in general physiology. He will also carry out some investigations with Dr. Abramson.

DR. ERIC PONDER lectured June 23 on "The Act of Blinking." Mr. Julius Abels, the holder of the John D. Jones Scholarship this summer, is assisting Dr. Ponder during the summer; and Mr. John MacLeod will continue to assist Dr. Ponder and to teach in the general physiology course.

DR. I. R. TAYLOR is again in charge of the course in general physiology. Mrs. Taylor and their children will not be here this year.

DR. JOHN Z. YOUNG of Oxford University, and MRS. YOUNG, have been at the Laboratory since the middle of June. Dr. Young is doing research on giant nerve fibres, and is taking part in the conference-symposia.

DR. HOMER SMITH has been appointed chemist in the Biophysics laboratory in the place of Dr. Edwin J. Hart, who is now with the U. S. Rubber Company. Mr. Thomas T. Goldsmith, Jr. is physicist, in place of Dr. Howard J. Curtis who is now research associate with Dr. K. S. Cole.

The program of evening lectures scheduled for the first part of the summer follows:

Tuesday, June 30th—Dr. George W. Corner: *The History of the Discovery of the Lymphatic System.*

Tuesday, July 7th—Dr. E. H. Anthes: *The History and Development of the Microscope.*

Tuesday, July 14th—Dr. R. W. Gerard: *Brain Waves.*

Tuesday, July 21st—Dr. A. F. Blakeslee: *Differences Between People in Thresholds for Taste and Smell.*

THE EFFECT OF METHYLENE BLUE ON THE SPECTROPHOTOMETRIC PICTURE OF HEMOGLOBIN, CO-HEMOGLOBIN AND CN-HEMOGLOBIN

Dr. Matilda Moldenhauer Brooks
Research Associate, University of California

The purpose of these experiments was to find out the effect of methylene blue on the spectrophotometric picture of hemoglobin (hb) and of CO-hb and CN-hb of rabbits. The blood was taken by heart puncture, diluted to 1% with .4% NH_4OH and then analyzed immediately in the spectrophotometer. The extinction coefficients at wave lengths 540/560 mμ=R were determined. These values indicate the per cent. of oxy-hb present.

There were three main results in the visible spectrum; the absorption maximum of the CN-hb curve and the curve for blood containing methylene blue were found to be identical with that for oxy-hb; the time curve for blood containing CO and methylene blue showed 100% oxy-hb in a short time. When these results were compared with u. v. spectra, no differences in the absorption of hb or CN-hb were found. However, in the infra red spectrum there was a greater absorption in blood containing KCN. Eggert found differences in the absorption spectrum of the infra red region between blood containing CO and oxy-hb. He also found that blood containing methylene blue after being subjected to CO, gave the absorption for oxy-hb, thus corroborating the writer's findings.

The conclusions are as follows; the evidence for the change of CO-hb to oxy-hb by the action of methylene blue *without invoking the methemoglobin formation theory* seems unequivocal. This may be caused by a catalytic action on the part of methylene blue or a poising effect on the oxidation-reduction potential of the system making it compatible with the re-formation of oxy-hb.

THE PHOSPHATASE CONTENT OF THE DEVELOPING CHICK EMBRYO

Harry J. Lipman
Instructor in Embryology and Physiology, University of Pittsburg

Phosphatases have been discovered in a great variety of plant and animal tissues. The substrates upon which these enzymes act are phosphoric esters which are hydrolyzed by the action of the enzyme.

An excellent review of the literature on the Phosphatases is found in the recent volume of "the Ergebnisse der Enzymforschung" by Folley and Kay. In the introductory chapter the authors state that the accumulation of evidence points to the key position held by the substrates, phosphoric esters, in many of the processes taking place in living organisms. Alcoholic fermentation, muscular contraction, bone formation and lactation are all associated with the action of the phosphatases. The authors speak of the radical importance of these enzymes.

According to the classification attempted by these authors we distinguish five classes of phosphatases and a number of unclassified phosphatases. Class A includes the phosphomonoesterases which can be divided into at least four subclasses. The work reported here confines itself to Subclass I of Class A.

This enzyme occurs in kidney, bone, intestine, mammary gland, lung, blood plasma, leucocytes, etc. Its optimum pH lies between 9-10. As a substrate for this phosphatase beta glycerophosphate is used.

Although our interest in the enzyme was concerned primarily with its rôle in ossification, the present work did not give any direct answer to this question, because the phosphatase activity was determined for the embryo of the developing chick as a whole. However, a rapid increase of phosphatase activity coincides with a high ossification activity in the embryo.

For the determination of phosphatase activity the Brigg's modification of the Bell-Doisy colorimetric method for the determination of phosphorus was used. In the technique the amount of inorganic phosphate formed by the enzyme activity is measured and calculated in total milligrams (absolute values) and in milligrams per gram of wet body weight (relative values). The phosphatase content of the white, of the yolk and of the embryo was determined in eggs from white leghorn hens. The determinations were made in intervals of three days during the process of incubation.

The absolute values and the relative values for the whole egg have two maxima, one at six days and the other at fifteen days of incubation. The high activity of bone formation falls between the twelfth and the fifteenth day. The relative and the absolute values run parallel.

The relative phosphatase values for white, yolk and embryo show the same two maxima. The absolute values for white and yolk follow the same type of curve. However, the absolute data for the embryo give a fairly good S-type curve. As has been said before, the steepest part of the

curve coincides with the period of high ossification activity. When the absolute and relative values for the embryo are plotted together on the same graph, the drop of the relative values after the fifteenth day stands out conspicuously against the continuous S-type rise of the absolute values. This drop can be interpreted by the fact that from this day on the growth of the embryo proceeds at a very rapid rate with which the increase in phosphatase activity does not hold pace.

It was found that the material used had a high coefficient of variation. This was also true for the experimental data. These facts make the results less significant than was expected.

(This article is based on a seminar report given at the Marine Biological Laboratory on June 30).

THE PHYSIOLOGY COURSE

DR. LAURENCE IRVING

Director of the Course and Professor of Experimental Biology, University of Toronto

The course in physiology has begun work with the same staff as that of last year. The plan of work is also similar to that of previous years. Each instructor offers laboratory work in the subjects of his own special interest, according to the following titles:

- Drs. Chambers and Sichel—micromanipulation;
- Dr. Ferguson—tissue respiration, the enzyme carbonic anhydrase, and carbamino compounds;
- Dr. Fisher—the relation of oxygen and oxidation to the heart beat;
- Dr. Höber—permeability and secretion in the perfused tissues of frogs;
- Dr. Irving—examination of the acid-base equilibrium in tissues and in sea water;
- Dr. Michaelis—potentiometric determination of oxidation—reduction potentials;
- Dr. Prosser—characteristics of excitation, central nervous systems and rhythmic action.

Each subject of the laboratory work covers technical methods, but it also presents the relation of the methods to the particular biological material and the physiological significance of the results which can be obtained.

In addition to the regular laboratory work special demonstrations are to be given each Wednesday, along with conferences and discussions.

The first lectures are given by the staff of the course, followed later by other lectures in various physiological subjects which are related to the course. Any member of the local scientific community is welcome to attend these lectures and to enter the discussion.

After the formal part of the course is completed, there remains about a week for special work upon methods or problems arising out of the earlier laboratory work. This extra period may be useful in extending or perfecting some methodical procedure, or it may lead to the better formulation of a plan of research.

THE PHYSIOLOGY CLASS NOTES

The physiology class accepts with vigor the challenge of the embryology class to a soft ball game. They are trying, literally, to have the faculty on their side.

With equal vigor plans are being made for a picnic under the chairmanship of Dr. Marie Andersch. The rest of the committee consists of Miss Judith D. Smith, Mr. Daniel E. Lilly, and Mrs. Alburta B. Wood. Most of the scientists have indicated that they will take the prosaic chicken or lobster which was suggested. Several epicurians have indicated that they prefer the delicate flavor of fundulus or limulus. —*E. T.*

THE EMBRYOLOGY CLASS NOTES

Almost from the start the embryology class decided that every man (and woman) must have his play; therefore they set about organizing it, as all good scientists should. Charles Klamer was unanimously appointed chairman.

Perhaps the most important point in their program is their daily swim. So many people at the Mess complain that it was a lovely day for a swim, but they just did not have the time. Not so with the embryology class. Most of the class departs at three for a dip in the briny deep, making the work up in the dark hours of the night. Perhaps that accounts for the healthy complexions of the class as a whole.

Early this week, a notice to this effect appeared on the Physiology Bulletin Board, addressed to the Physiology Class; "We, the members of the 1936 Embryology Class of the Marine Biological Laboratory of Woods Hole, Massachusetts, do hereby challenge the members of the 1936 Physiology Class of said institution to a game of Soft Ball to be played at 7:15 P. M. on July 8, 1936, at a place later to be designated. Acceptance of this challenge will be expected in the next 48 hours or we shall consider physiologists of 1936 as completely lacking in any physical prowess!"

With this practically irresistible challenge under their belts, the class is relaxing from all its cares today at a beach party at Tarpaulin Cove. Baseball, swimming, picnic supper, and songs part of the program. Professors Grave, Packard, and Schotté have been invited to join the party. The *Winifred* was chartered for the occasion.

Pictures and notices announce the progress of social life to the world at large. The committees: Don Bauer—collecting money, Katherine Hummel—recreation (baseball and bat), Betsy Conant—bulletin board; Helen Froelich—food.

—*E. T.*

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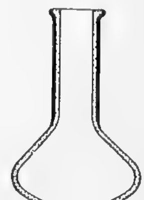

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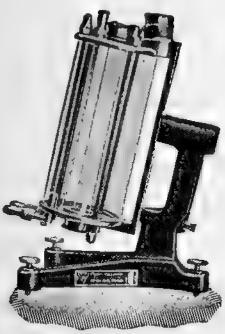

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DIRECTORY FOR 1936

KEY

Laboratories		Residence	
Botany Building	Bot	Apartment	A
Brick Building	Br	Dormitory	D
Lecture Hall	L	Drew House	Dr
Main Room in Fisheries Laboratory	M	Fisheries Residence	F
Old Main Building	OM	Homestead	Ho
Rockefeller Bldg.	Rock	Hubbard	H
		Kahler	Ka
		Kidder	K
		Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY

THE STAFF

Jacobs, M. H. director. prof. gen. phys. Pennsylvania.

EMBRYOLOGY

Investigation

Instruction

Barth, L. G. asst. prof. zool. Columbia.
Goodrich, H. B. prof. biol. Wesleyan. (absent 1936)
Grave, B. H. prof. biol. De Pauw.
Hoadley, L. prof. zool. Harvard.
Packard, C. asst. prof. zool. Inst. of Cancer Research, Columbia.
Schotté, O. asst. prof. biol. Amherst.

PROTOZOOLOGY

Investigation

Instruction

Calkins, G. N. prof. proto. Columbia.
Drumtra, Elizabeth instr. zool. Wilson.
Kidder, G. W. instr. zool. City of New York.

PHYSIOLOGY

Investigation

Amberson, W. R. prof. phys. Tennessee.
Bradley, H. C. prof. phys. chem. Wisconsin.
Garrey, W. E. prof. phys. Vanderbilt Med.
Lillie, R. S. prof. gen. phys. Chicago.
Mathews, A. P. prof. biochem. Cincinnati.

Instruction

Chambers, R. prof. biol. New York.
Ferguson, J. K. W. asst. prof. phys. Western Ontario.
Fisher, K. C. demon. biol. Toronto.
Höber, R. visit. prof. phys. Pennsylvania.
Irving, L. prof. expt. biol. Toronto.
Michaelis, L. mem. Rockefeller Inst.
Prosser, C. L. instr. biol. Clark.
Sichel, F. J. M. instr. zool. Pennsylvania.

BOTANY

Investigation

Allen, C. E. prof. bot. Wisconsin.
Brooks, S. C. prof. zool. California.
Duggar, B. M. prof. phys. & econ. bot. Wisconsin.
Lewis, I. F. prof. biol. Virginia.
Robbins, W. J. prof. bot. Missouri.

Instruction

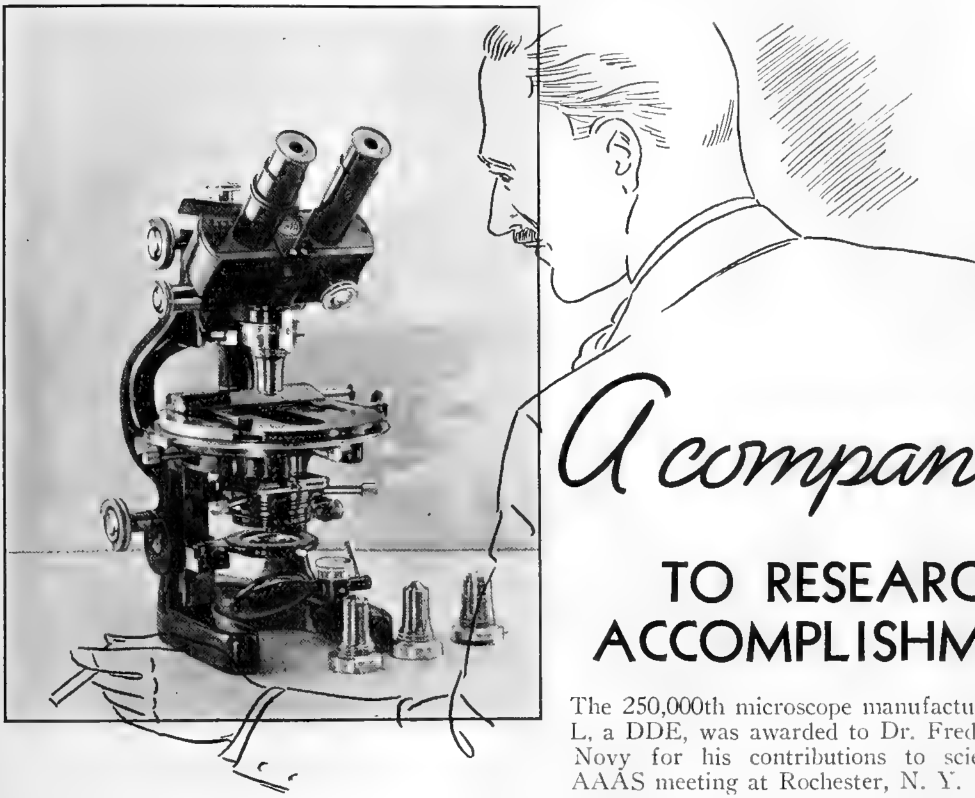
Drouet, F. res. fel. Missouri.
Prescott, G. W. asst. prof. biol. Albion.
Taylor, W. R. prof. bot. Michigan.

INVESTIGATORS

Abramowitz, A. A. res. asst. zool. Harvard. Br 213. Ka 24.
Albaum, H. G. grad. zool. Columbia. Br 314. Ka 22.
Algire, G. H. grad. Maryland Med. Rock 3. Hamblin, Government.
Allee, W. C. prof. zool. Chicago. Br 332. A 101.
Amberson, W. R. prof. phys. Tennessee. Br 109. Gansett.
Angerer, C. A. instr. zool. Pennsylvania. Br 111. Stevenson, School.
Appel, Elizabeth McK. grad. bact. School of Hygiene, Hopkins. Bot 1. Daniels, Millfield.
Appel, F. W. assoc. prof. biol. St. John's (Annapolis). Bot 1. Daniels, Millfield.
Armstrong, P. B. asst. prof. anat. Cornell Med. Br 318.
Ashton, Miriam instr. biol. British Columbia (Canada). Bot upstairs. WA.
Ball, E. G. assoc. phys. chem. Hopkins Med. Br 110. D 315 B.
Ballard, W. W. asst. prof. biol. Dartmouth. Br 217 h. D 112 B.
Barth, L. G. asst. prof. zool. Columbia. Br 210. D 101.
Bernstein, F. visit. prof. math. Columbia. Br 122 b. Cassidy, Millfield.
Bernstein, Marianne E. Barnard. Br 122 b. Cassidy, Millfield.
Brinley, F. J. asst. prof. zool. North Dakota. OM 38. D 302.
Brooks, Matilda M. res. assoc. biol. California. Br 343. D.
Brooks, S. C. prof. zool. California. Br 343. D.
Brown, D. asst. prof. phys. New York Univ. Med. Br 214. Hyatt.
Buchheit, J. R. Br 319. Howe, School.
Budington, R. A. prof. zool. Oberlin. Br 218. Orchard.
Cable, R. M. asst. prof. parasit. Purdue. Br 126. D 110.
Calkins, G. N. prof. proto. Columbia. Br 331. Buzzards Bay.
Cannan, R. K. prof. chem. New York Univ. Med. Br 309. Gardiner.
Carmichael, J. C. Vanderbilt Med. Br 233. Dr 2.
Chambers, R. prof. biol. New York. Br 328. Falmouth.
Cheney, R. H. prof. biol. Long Island. Br 118. A 302.
Child, G. P. res. asst. gen. Amherst. Br 204. Plough, Agassiz.
Churney, L. instr. zool. Pennsylvania. Br 220. Cowey, School.
Clement, A. C. asst. prof. biol. Charleston. Br 217 g. Rogers, Quisset.
Clowes, G. H. A. dir. Lilly Res. Labs. Br 328 b. Nobska.
Coe, W. R. prof. biol. Yale. Br 323. A 202.
Coker, R. E. prof. zool. N. Carolina. Bot 6. Jennings, Whitman.
Compton, A. D., Jr. asst. biol. Yale. Br 323. Bar Neck.

Copeland, D. E. asst. biol. Amherst. Br 204. K G.
Copeland, M. prof. biol. Bowdoin. Br 334. Gardiner.
Corey, H. Irene res. asst. cyt. Pennsylvania. Br 219. D 308.
Corson, S. A. res. assoc. phys. New York. Br 330. Young, West.
Cowdry, E. V. prof. cyto. Washington (St. Louis). Br 305. Millfield.
Crowell, S. instr. biol. Brooklyn. L 25. Bar Neck.
Denny, Martha asst. zool. Barnard. Br 217 f. Grinnell, Bar Neck.
Dildine, G. C. instr. zool. Northwestern. Br 315. Hilton, Water.
Donaldson, H. H. mem. Wistar Inst. Br 115. Buzzards Bay.
Donnellon, J. A. grad. zool. Pennsylvania. OM Base. Mendel, High.
Dornfield, E. J. asst. zool. Wisconsin. OM 34. D 111.
Dowding, Grace L. lab. asst. Maryland Med. Rock 6. D 212.
Dreyer, W. A. instr. zool. Cincinnati. Br 334. D 214.
Drouet, F. res. fel. bot. Missouri. Bot 23. Young, West.
Drumtra, Elizabeth instr. biol. Wilson (Penn.). OM 22. A 307.
Embden, Maja res. asst. Johann Wolfgang Goethe (Germany). Br 107. D 310.
Emerson, H. S. res. asst. exper. emb. Amherst. Br 204. Dr 6.
Ets, H. N. assoc. prof. pharm. Loyola Med. (Chicago). L 22. A 203.
Evans, Gertrude res. asst. zool. Chicago. Br 332. K 3.
Fennell, R. A. grad. biol. Hopkins. Br 329. Dr 210.
Ferguson, J. K. W. asst. prof. phys. Western Ontario. Br 108. Savery, Falmouth.
Figge, F. H. J, assoc. prof. anat. Maryland Med. Rock. D 210.
Fisher, K. C. demon. exp. biol. Toronto. OM 9 & 7. Ka 1.
Flynn, C. M. instr. zool. Maine. OM 41. Griffin, High.
Forman, R. C. Amherst Med. Br 204. Dr attic.
Frankenstein, N. A. Marquette. OM 34. D 111.
Garrey, W. E. prof. phys. Vanderbilt Med. Br 215. Gardiner.
Gerard, R. W. assoc. prof. phys. Chicago. Br 339. D 205.
Glassman, H. N. res. asst. phys. Pennsylvania. Br 205. Ka 22.
Godrich, J. res. asst. Columbia. Br 210. McLeish, Millfield.
Goffin, Catherine E. res. asst. cyt. Lilly Res. Labs. OM Base. F.
Goldin, A. asst. biol. Brooklyn. OM 39. Ka 23.
Grave, B. H. prof. zool. De Pauw. Br 234. K 10.
Greey, Elizabeth L. res. asst. exp. biol. Toronto. Br 107. D 310.
Grubden, Maria E. Frankfurt Med. (Germany). Br 107. D 310.
Gurwen, Alice O. asst. prof. anat. Woman's Med. Penna. Bot. K 3.
Halbreich, M. A. grad. phys. Pennsylvania. Br 122. K 12.
Hartline, H. K. lect. biophysics Pennsylvania. Br 339. Lucké, Minot.
Harvey, Ethel B. invest. biol. Princeton. Br 116. Gosnold.
Heilbrunn, L. V. assoc. prof. phys. Pennsylvania. Br 221. Edwards, School.
Hershkowitz, S. G. New York Med. OM 25. McLeish, Millfield.
Hess, W. N. prof. zool. Hamilton. Br 122d. A 301.
Hill, E. S. res. asst. biochem. Washington Med. (St. Louis). Br 207. D 317.
Hill, S. E. res. asst. phys. Rockefeller Inst. Br 209. Veeder, West.
Hoadley, L. prof. zool. Harvard. Br 115. D 308.
Höber, Josephine invest. phys. Pennsylvania. Br 313. D 301.
Höber, R. visit. prof. phys. Pennsylvania. Br 313. D 301.
Hobson, L. B. grad. asst. zool. Cincinnati. L 26. Ka 1.
Hopkins, D. L. asst. prof. zool. Duke. OM 5. Metz, Hyatt.
Holtfreter, J. privatdozent. emb. München. Br 312. Lewis, Buzzards, Bay.
Hornor, Helen B. teach. asst. biol. Barnard. Br 314. W E.
Hörstadius, S. assoc. prof. zool. Stockholm. Br 125. Wilde, Gardiner.
Horton, R. G. grad. phys. Cornell. OM 3. Clough, Millfield.
Hunninen, A. V. asst. parasit. Sch. Hygiene, Hopkins. Br 217. K 7.
Hunter, F. R. teach. asst. phys. Princeton. Br 231. Ka 24.
Hunter, Laura N. grad. zool. Pennsylvania. Br 217d. W A.
Irving, L. prof. exp. biol. Toronto. Br 107. D 303.
Jacobs, M. H. prof. gen. phys. Pennsylvania. Br 102. (Sippewissett).
Jenkins, Betty grad. asst. zool. George Washington. OM 46. Gosnold.
Jenkins, G. B. prof. anat. George Washington Med. OM 46. Gosnold.
Johlin, J. M. assoc. prof. biochem. Vanderbilt Med. Br 233. Park.
Kaliss, N. grad. asst. zool. Columbia. Br 314. Vincent, East.
Kaylor, C. T. fel. emb. Princeton. Br 127. Kreke, Buzzards Bay.
Keil, Elsa M. asst. prof. phys. Rutgers. OM base. W E.
Keltch, Anna K. res. chem. Lilly Res. Labs. Br 319. Howe, School.
Kidder, G. W. instr. biol. City of N. Y. OM 21. Park.
Knower, H. McE. res. assoc. biol. Yale. Br 323. Peterson, Millfield.
Knowlton, F. P. prof. phys. Syracuse Med. Br 226. Gardiner.
Kopac, M. J. res. assoc. biol. New York. Br 328. A 106.
Korr, I. M. fel. phys. Princeton. Br 231. Young, West.
Krahl, M. E. res. biochem. Lilly Res. Labs. Br 333. Howe, Main.
Lancefield, D. E. assoc. prof. zool. Columbia. Br 335. Sturtevant, Agassiz.
Lancefield, Rebecca C. assoc. bact. Rockefeller Inst. Br 208. Sturtevant, Agassiz.
Lederman, E. undergrad. asst. zool. Miami. Br. 341. K 15.
Levin, L. DePauw. Br 234. Dr 2.
Levine, D. S. instr. biol. Theodore Roosevelt High (N. Y. C.). Bot 1. Fletcher, Bar Neck.
Lillie, F. R. prof. zool. Chicago. Br 101. Gardiner.
Lillie, R. S. prof. phys. Chicago. Br 326. Gardiner.
Lindeman, V. F. asst. prof. zool. Syracuse. Br 226. Crowell, School.
Lipman, H. J. instr. emb. Pittsburg. Rock 7. Ka 21.
Loomis, W. E. assoc. prof. plant phys. Iowa State. Br 223. Dodge, Shore.
Lucas, A. M. assoc. prof. zool. Iowa State. Br 223. K 8.
Lucas, Miriam S. Br 223. K 8.
Lucké, B. prof. path. Pennsylvania Med. Br 311. Minot.

(Continued on Page 23)



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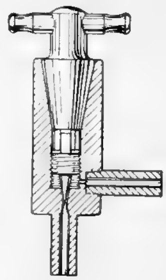

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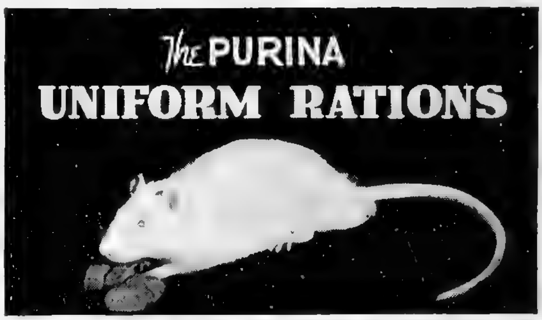

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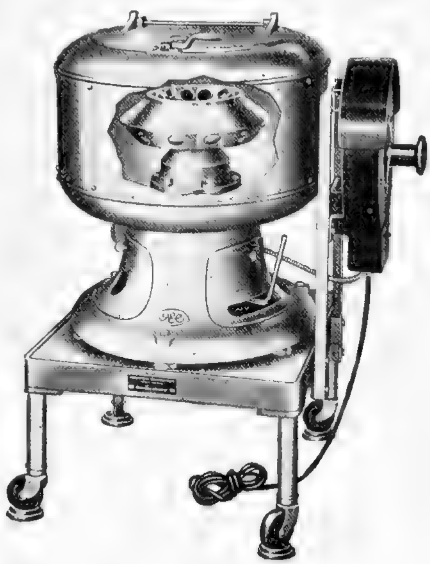

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Luyet, B. J. assoc. prof. biol. St. Louis. Br 217. (Left June).
Maclean, Bernice L. instr. emb. Hunter. L 28. Smith, East.
Magruder, S. R. res. assoc. zool. Cincinnati. L 31. Neal, Bar Neck.
Marsland, D. A. asst. prof. biol. New York. Br 123. Ferris, Glendon.
Martin, E. A. prof. biol. Brooklyn. OM 39. Newman, Gardiner.
Martin, W. E. instr. biol. Purdue. Br 126. D 211.
Mast, Elisabeth T. res. asst. psych. Hopkins. Br 329. Minot.
Mast, S. O. prof. zool. Hopkins. Br 329. Minot.
Matthews, A. P. prof. biochem. Cincinnati. Br 222. Buzzards Bay.
Mayo, Virginia teach. biol. Dana Hall Sch. (Wellesley). Br 217b. H 8.
Mazia, D. fel. zool. Pennsylvania. Br 122. Edwards, School.
McClung, C. E. dir. zool. Lab. Pennsylvania. Br 219. A 201.
Michaelis, L. mem. Rockefeller Inst. Br 207. Dantchakoff, Gansett.
Miller, F. W. invest. gen. Amherst. Br 204. K 9.
Monke, J. V. teach. fel. phys. Tennessee Med. Br 109. Dr 2.
Moore, J. A. asst. zool. Columbia. Br 303. Dr.
Moser, F. grad. biol. Pennsylvania. Br 111. D 318.
Nabrit, S. M. prof. biol. Atlanta. L 33. A 105.
Nestler, H. A. reader, biol. Brooklyn. OM 39. Ka 25.
Newman, M. grad. phys. Pennsylvania. OM base. Dr attic.
Nonidez, J. F. asst. prof. anat. Cornell Med. Br 318. Whitman.
Novikoff, A. B. tutor. biol. Brooklyn. Br 314. K 15.
Nunnemacher, R. F. asst. hist. Harvard. Br 315e. Nickelson, Main.
O'Brien, J. P. grad. emb. Hopkins. Bot 1. Mendel, High.
Odlaug, T. O. grad. biol. New York. Br 232. Dr attic.
Orr, P. R. instr. biol. Brooklyn. OM 44. Hilton, Hilton.
Osterhout, W. J. V. mem. Rockefeller Inst. Br 209. MacNaught, Whitman.
Packard, C. asst. prof. zool. Columbia Inst. Cancer Res. OM 2. North.
Painter, Elizabeth E. instr. phys. Maryland Med. Br 225. D 212.
Pappenheimer, J. R. Harvard. Br 208. Röhmeling, Pleasant.
Parker, G. H. emer. prof. zool. Harvard. Br 213. A 308.
Parpart, A. K. asst. prof. phys. Princeton. Br 231. Jacobs, Minot.
Peabody, Elizabeth B. prof. biol. St. Elizabeth Convent (N. J.). L 24. Veeder, West.
Prescott, G. W. asst. prof. biol. Albion. Bot 26. D 107.
Prosser, C. L. asst. prof. phys. Clark. Br 228. Cowie, School.
Puckett, W. O. instr. anat. & emb. Princeton. Br 344. Silvia, Quisset.
Ricca, R. A. res. asst. biophysics. Pennsylvania. Br 339. Stuart, School.
Richards, O. W. instr. biol. Yale. Br 8. D 307. (Absent between July 4 and Aug. 25).
Robertson, C. W. asst. biol. New York. Br 123. D 314.
Robinson, R. A. Col. Physicians & Surgeons. OM 24. Robinson, Quisset.
Rose, E. T. worker. Iowa Conserv. Com. Bot. D 107.
Rugh, R. instr. zool. Hunter. OM 43. Hubbard Bungalow, East.
Salk, J. fel. biochem. New York Univ. Med. Br 309. Dr 5.
Saslow, G. asst. prof. phys. New York. Br 214. Gigger, Gardiner.
Schechter, V. instr. biol. City of N. Y. Bot 1. Dr 6.
Schenthal, J. E. res. fel. anat. Maryland Med. Rock 6. Hamblin, Government.
Schotté, O. E. asst. prof. biol. Amherst. OM 4. Lehy, Millfield.
Schwab, J. J. asst. biol. Chicago. Br 10. White, Water.
Scott, A. C. instr. biol. Union. OM base. Metz, Hyatt.
Scott, Birdie L. grad. asst. biol. Atlanta & Spelman. L 33. D 208.
Seitchik, J. Pennsylvania. Br 217. K 12.
Shaw, I. res. asst. zool. Long Island. Br 118. Bosworth, North.
Sichel, F. J. M. fel. Royal Soc. Canada. biophysics. Pennsylvania. Br 228. Dr 2.
Smith, C. C. sen. res. asst. chem. DePauw. Br 221. Dr 1.
Smith, D. C. instr. phys. Tennessee. Br 109. (Left June).
Smith, J. A. asst. zool. DePauw. Br 234. Dr 2.
Solberg, A. N. fel. zool. Columbia. Br 314. D 206.
Specht, H. asst. phys. N. Y. Univ. Med. Br 214. Mast, Minot.
Speicher, B. R. res. fel. cyt. Columbia. Rock 2. Metz, Hyatt.
Speidel, C. C. prof. anat. Virginia Med. Br 106. D 315a.
Stanbury, J. B. Harvard Med. Br 109. McLeish, Millfield.
Steinbach, H. B. instr. zool. Minnesota. Br 210. Edwards, School.
Stern, K. G. visit. lect. phys. chem. Yale. Br 328. Howes, Water.
Stock, C. C. grad. phys. chem. Hopkins Med. Br 224. D 215b.
Stockard, C. R. prof. anat. Cornell Med. Br 317. Buzzards Bay.
Stunkard, H. W. prof. biol. New York. Br 232. Buzzards Bay.
Summers, F. M. instr. biol. Bard (N. Y.). Br 217k. Oaks, Park.
Szepsenwol, J. chef des travaux Anatomie. Geneva. Br 312. D 9.
Taft, C. H., Jr. assoc. prof. pharm. Texas Med. L 23. Whitman.
Tashiro, S. prof. biochem. Cincinnati Med. Br 341. Park.
Taylor, J. F. grad. phys. chem. Hopkins Med. Br 319. Howes, Water.
Taylor, W. R. prof. bot. Michigan. Bot 24. Whitman.
Teitelbaum, H. A. instr. anat. Maryland Med. Rock 3. Hamblin, Government.
Thompson, J. U. res. fel. anat. Maryland Med. Rock 3. Hamblin, Government.
Thornton, C. S. asst. biol. Princeton. Br 344. Silvia, Quisset.
Tracy, H. C. prof. anat. Kansas Med. L 32. Hilton, Glendon.
Uhlenhuth, E. prof. anat. Maryland Med. Rock 3. Brooks.
Walker, R. instr. biol. Rensselaer Polytechnic. OM 43. Dr 10.
Warren, M. R. grad. asst. zool. Cincinnati. L 26. Ka 1.
Wichterman, R. Temple. L 217.
Wilson, E. B. emer. prof. zool. Columbia. Br 322. Buzzards Bay
Wolf, E. res. assoc. phys. Harvard. Br 110. D 202.
Wolf, E. A. assoc. prof. biol. Pittsburgh. Rock 7. Elliot, Center.

Wolf, Opal M. lect. zool. Barnard. OM 1. Cassidy, Millfield.
Yntema, C. L. instr. emb. Cornell Med. L 27. D 102.
Young, Roger A. asst. prof. biol. Howard. Br 315. A 304.
Young, S. B. tech. phys. Rockefeller Inst. Br 209. D 218.
Youngstrom, K. A. instr. anat. Kansas. L 32. Hilton, Glendon.

STUDENTS

Ades, H. W. teach. asst. zool. Illinois. emb. (Hyannis).
Andersch, Marie asst. prof. phys. chem. Womans Med. (Philadelphia). phys. Cowey, School.
Arthur, J. K., Jr. lab. asst. Amherst. emb. Dr 6.
Ballentine, R. Princeton. phys. D 316.
Bauer, D. de F. Dartmouth. emb. Dr attic.
Berenberg, Naomi R. N. J. Coll. for Women. proto. W B.
Bloch, Janet E. Sarah Lawrence. emb. H 7.
Bocskey, S. C. asst. prof. biol. Notre Dame, proto. White, Water.
Brooks, Jeanne R. Oberlin. emb. W I.
Brush, Ruth M. Hunter. proto. Kreke, Buzzards Bay.
Bush, Aeleta N. grad. biol. Emory (Georgia). proto. D 203.
Cameron, J. A. C. instr. zool. Missouri. phys. Young, West.
Chambers, A. H. Swarthmore. phys. Dr. 7.
Claff, C. L. alum. Bowdoin. proto. A 208.
Clark, Beatrice instr. biol. Brooklyn Botanic Garden. emb. Young, West.
Colie, Elizabeth S. grad. biol. Columbia. emb. Googins, Quisset.
Conant, Betsy D. Rochester. emb. H 4.
Culberson, Mabel H. instr. bact. Simmons & Farmington St. Normal. emb. Sylvia, Quisset.
Cunningham, Katherine American (D.C.). proto. H 4.
Danner, E. C. asst. instr. biol. Illinois. emb. Ka 2.
Dewey, Virginia C. tech. Harvard Med. proto. Sylvia, Quisset.
Dugal, L. P. instr. biol. Montreal. phys. McLeish, Millfield.
Ferenbach, C. Princeton. proto. Cahoon, Falmouth.
Forbes, T. R. fel. anat. Rochester Med. emb. K 6.
Fowler, W. S. Swarthmore. emb. K.
Froelich, Helen L. lab. asst. zool. Stephens (Mo.) emb. D 304.
Fronczak, M. I. asst. advis. biol. Seton Hall (N. J.) emb. Mendel, High.
Gayer, H. K. Oberlin. emb. Ka 4.
Giles, G. H. teach. biol. Beaver Creek H. S. (Wyo.). bot. Ka 2.
Goldwasser, S. res. asst. physic. chem. Amherst. phys. (Hyannis).
Greenfield, S. S. Brooklyn. proto. Ka 4.
Grossman, Cecelia M. teach. biol. Abraham Lincoln H. Sch. (Brooklyn). proto. Howes, Water.
Grossman, J. grad. biol. Columbia. phys. Vincent, East.
Henson, Margaret Smith. emb. D 204.
Hudson, Grace P. Hunter. proto. D 103.
Hummel, Katharine P. instr. zool. Mt. Holyoke. emb. Smith, East.
Johnson, D. F. instr. biol. Southern (Florida). emb. Bosworth, North.
Joslin, S. L. lab. asst. Wesleyan. emb. K 6.
Kennedy, Kathleen M. demon. biol. Memorial (Newfoundland). emb. H 2.
Klamer, C. H. Wabash (Ind.) emb. Dr 5.
Kriete, B. C. undergrad. asst. DePauw. emb. Dr 2.
Lee, G. O. instr. biol. Canal Zone, H. S. and Jr. Col. proto. Lewis, Buzzards Bay.
Lewis, Lena A. tech. bact. Lancaster Gen. Hosp. (Pennsylvania). phys. D 204.
Lewis, Wilma undergrad. asst. biol. State Teachers (Montclair). proto. Cassidy, Millfield.
Lilly, D. M. instr. gen. biol. Providence. phys. Smith, North.
Lipman, H. J. grad. asst. biol. Pittsburgh. emb. Ka 2.
Magalhaes, Hulda grad. asst. phys. Mt. Holyoke. phys. W D.
Magers, Elizabeth J. asst. prof. phys. Vassar. phys. A 306.
Margolis, F. J. Pittsburgh. phys. Ka 21.
McCarrell, Jane D. instr. phys. Vassar. emb. A 305.
McDonald, Margaret R. sen. tech. chem. Rockefeller Inst. Med. Res. phys. Swain, Millfield.
Meglitsch, P. A. grad. biol. Illinois. proto. Young, West.
Mendoza, G. teach. asst. zool. Northwestern. emb. Hilton, Glendon.
Metcalf, S. H. grad. teach. asst. hist. Columbia. proto. High.
Mills, Katharine O. tech. & asst. zool. Missouri. phys. W G.
Mitchell, Alison M. N. J. Col. Women (New Brunswick). proto. W B.
Mock, Sarah H. teach. biol. Trenton Junior (Mo.). proto. D 207.
Moragues, V. grad. med. Barcelona (Spain). phys. Dr 8.
Morgan, T. J. fel. biol. Washington and Jefferson. emb. Dr 5.
Pack, Virginia L. Sarah Lawrence. emb. H 8.
Palmer, C. M. asst. prof. bot. Butler (Indiana). bot. Kreke, Buzzards Bay.
Poole, Margery G. Radcliffe. bot. W G.
Price, J. W. assoc. prof. vert. zool. Ohio St. emb. (Falmouth).
Ratnoff, O. D. Phys. and Surg. (Columbia). phys. D 216.
Reddick, Mary grad. asst. gen. biol. Atlanta and Spelman (Georgia). emb. D 208.
Reed, E. A. teach. asst. zool. California. phys. Dr attic.
Richardson, Estelle D. grad. biol. New York. phys. Grennell, West.
Rosenfield, R. E. Pittsburgh. phys. Ka 21.
Russell, Alice M. instr. biol. Illman Carter (Pennsylvania). emb. Gray, Buzzards Bay.
Scheer, Beatrice A. asst. bot. Connecticut. bot. D 305.
Schneider, Ruth Skidmore. emb. H 7.
Shurtleff, Rosamond L. Wheaton. bot. H 3.
Shykin, Pearl Radcliffe. emb. H 2.
Smith, G. L. undergrad. asst. biol. DePauw. emb. Dr attic.
Smith, Judith D. asst. phys. Wellesley. phys. Young, West.
Smith, P. E. grad. asst. bot. Rochester. phys. K 3.
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Trombetta, Vivian V. asst. bot. Barnard. bot. D 305.
Velasquez, G. T. grad. bot. Michigan. bot. Dr 14.
Walborn, Rebecca S. grad. asst. zool. Missouri. emb. D 304.
Williams, Jean L. asst. bot. Wellesley. bot. A 205.
Wood, Alburta B. phys. Albert, Spencer Baird.

NOTE: The directory for 1936 will be issued in phamplet form at the end of next week and will be complete up to July 8. It will include the staff of the several departments of the Marine Biological Laboratory as well as those of the Woods Hole Oceanographic Institution and the United States Bureau of Fisheries. It will also contain the "A B C of Woods Hole" and a map. Single copies will cost 25c.

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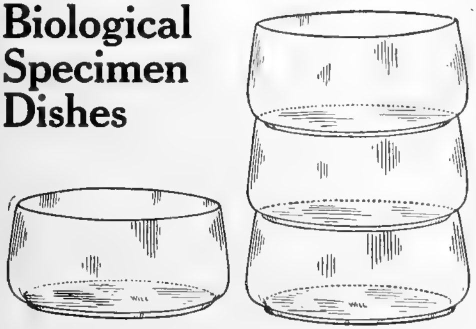

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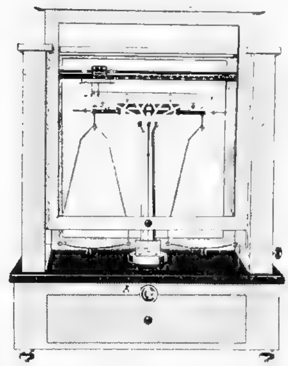

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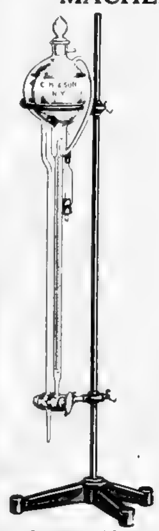

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THE M. B. L. CLUB MIXER

With a record breaking attendance, a birthday celebration, and a five-piece orchestra the M. B. L. Club opened the social season with a gala Mixer last Saturday night at the clubhouse.

The affair was open to everyone in the colony and on Saturday evening lights in the laboratories were few and far between. At nine-fifteen, when the hall was packed to capacity, a birthday cake was presented to Dr. Frank Lillie, President of the M. B. L. Corporation and past Director of the Laboratory, in honor of his sixty-sixth birthday. The cake was a surprise to everyone, including Dr. Lillie; after a short thank-you speech, he succeeded in blowing out all the candles with the assistance of a young lady upon whom he called for help.

The cutting of the cake was the signal for general refreshments, and soon everyone was supplied with punch and cakes. By this time it was evident that the social committee was a decided success, first in its plan for labeling everyone who entered the club with his name and institution, and later with its action in keeping everyone circulating and meeting new people. When the orchestra arrived many newly-formed acquaintances were chatting in friendly groups in various parts of the rooms.

Dancing began at half past ten to the sprightly tunes of Freddie Joseseck and his orchestra from New Bedford. The dance floor, both upstairs and down, was crowded with couples until the dancing stopped a minute or two after midnight.

Arrangements for the Mixer were capably carried out under the direction of three committee chairmen. The refreshment committee consisted of Stewart Joslin, *chairman*, J. B. McKeen Arthur, Phyllis McClure, and Jeanne Brooks; the social, Elisabeth Mast, *chairman*, Margaret Mast, Persus Crowell, Alice Gigger, Helen Froelich, Paul Smith, and Howard Liljestrand; the decoration, Kenneth Gayer, *chairman*, Marie Ancersch, Virginia Pack, Janet Blich, Elizabeth Thornton, and Carl Ferenbach; the publicity, Charles Klamer, *chairman*, Mary Connor, Elsa Keil, Amy Gamble, and Ursula Reinhardt.

The rooms of the club were beautifully decorated with flowers, and crepe paper and balloons added a festive touch to the whole affair. Cut flowers and ferns were supplied through the courtesy of Nichols of Falmouth; palms, potted flowers and plants through the courtesy of Lawrence, also of Falmouth. —*E. T.*

CHORAL CLUB

The Woods Hole Choral Club, an old and established institution, began its tenth season Thursday, July 2, under the direction of Professor Ivan Gorokhoff of Smith College. The chorus is made up of Laboratory workers and residents of the community who like to sing good music. Some of the present members have been connected with it from its beginning in 1926, but a large proportion each year consists of singers who are new to Woods Hole.

Among the musical numbers selected for this season's practice are compositions by Händel and Wagner, Russian and German folk songs, and English madrigals. The public performance will be given in the Marine Biological Laboratory Auditorium about the middle of August. All who like to sing and are willing to attend the rehearsals regularly are invited to become members; the rehearsals are every Tuesday at 9 P. M. and Thursday at 8 P. M. This opportunity to sing good music under able direction has been appreciated by many students and investigators.

Dr. Fred W. Appel, associate professor of biology at St. John's College in Annapolis, was married on June 18 and recently returned to Woods Hole with his bride. They are living in Daniel's cottage on Millfield Street.

DEPARTMENT OF BOOKS

A TREATMENT ON THE VARIATIONS IN NERVOUS ORGANIZATION

THE COMPARATIVE ANATOMY OF THE NERVOUS SYSTEM OF VERTEBRATES, INCLUDING MAN, Kappers, C. U. Ariens, Huber, G. C., and Crosby, E. C., 2 vols., xxvi & 1845 pp., 710 figs. 1936. $16.00. The Macmillan Company, New York.

This monumental work makes available for the first time in the English language an adequate account of the comparative anatomy of the nervous system of vertebrates. In preparation for nearly ten years, these volumes present in a greatly detailed, yet clear, orderly, and interesting fashion, the present-day knowledge of the subject.

In 1920-1921, one of the authors (Kappers) published "Die vergleichende Anatomie des Nervensystems." An English translation and revision of this was at first planned. However, the more recent contributions to the knowledge of the comparative anatomy of the nervous system were so

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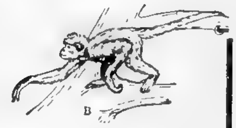

Hegner's COLLEGE ZOOLOGY

has been completely revised, reset and printed from new plates for the new Fourth Edition published this spring. Although the original plan of study has not been altered, there has been much new material incorporated, a whole series of new drawings and reproductions of the best photographs made available by modern methods of photography. There is a new section on the grasshopper, new chapters on the Relations of the protozoa to Man and Parasitism in Animals, considerable new material on the vertebrates and many other important additions to the text throughout. $3.50

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Woodruff's FOUNDATIONS OF BIOLOGY

long one of the most widely used texts in its field, has now been published in a thoroughly revised Fifth Edition. The most noteworthy points of revision are the addition of two new chapters giving a synoptic view of the representatives of the plant and animal kingdom and the addition of about 100 new illustrations. All material has been brought up-to-date, but the basic spirit of the book in its presentation of a broad survey of the fundamental principles of biology has not been changed. $3.50

Baitsell's MANUAL OF BIOLOGY

primarily for use with Woodruff's text, has also been revised to incorporate new material on plant types, especially with regard to the Algae, Fungi, and Seed Plants, a new section on the Grasshopper, and new sections at the end of the chapters on related facts of importance. Many of Harrison's magnificent habitat groups have been used as illustrations for this new edition. Although the Manual follows Woodruff's text, it is so full that it can be used with any other standard text. $2.50

Mavor's GENERAL BIOLOGY

a new text by Professor James Watt Mavor of Union College, will be published in July. The book is divided into five main sections on the Nature of Life, Plant Life, Invertebrates, Vertebrates, and Principles. In so far as is compatible with scientific treatment, the author has taken pains to satisfy the wish of every student beginning the study of biology to learn about his own life. The relation of animals to man is constantly pointed out, and the services of biology to mankind indicated at appropriate points in the study. The whole text is very full, and, in order to give latitude to the teacher, alternative types have been discussed in several instances. An accompanying laboratory manual will be ready in the fall.

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extensive that it was decided to rewrite the text completely. The present volumes are therefore a new piece of work, and not a translation. Furthermore, they are thoroughly up to date (to 1935).

Following the preface and brief introduction, come ten chapters with the following titles: I, The Evolution and Morphology of Nervous Elements; II, The Comparative Anatomy of the Spinal Cord; III, The Medulla Oblongata; IV, The Lateral Line and Acoustic Systems; V, The Effectory System of the Midbrain and the Medulla Oblongata; VI, The Coordinating Apparatus; VII, The Cerebellum; VIII, The Mesencephalon and the Diencephalon; IX, The Submammalian Telencephalon and the Mammalian Telencephalon Exclusive of the Non-Olfactory Cortex; X, The Development of the Cortex in Mammals. These chapters are characterized by an orderly and logical arrangement of the material presented under many sub-headings. A large number of well-chosen illustrations are included throughout the book. An author index and a subject index are given at the end. The text throughout is singularly free from errors.

Although it is not possible to give a satisfactory brief review of a technical work of this magnitude, attention may be called to a few outstanding features. Perhaps the most noteworthy is the extraordinary completeness of the work. Practically nothing that has been done in the field by the investigators of this or other countries has escaped the attention of the authors. This is reflected in the extensive and extremely valuable bibliographies to be found at the end of each chapter. For example, the first chapter dealing with the evolution and morphology of the nervous elements covers 94 pages; the appended bibliography for this chapter takes up 40 pages. Presentation of the results obtained by so many workers necessarily requires a somewhat synoptic manner of writing in many places.

A brief résumé is given at the end of each chapter. In the case of a long chapter several résumés are given, spaced at appropriate intervals. These résumés are of special interest in some cases since they include important generalizations and conclusions based on the foregoing detailed accounts. Thus, the résumé for Chapter III begins as follows: "The medulla oblongata differs from the spinal cord in the greater development of its dorsal roots as compared with its ventral roots. The underlying cause for the hypertrophy of the dorsal roots is to be found in the development of the gill apparatus and the sense organs of the region. The nerves of the branchial arch apparatus must be regarded as specialized components of the dorsal roots which originally contained, in addition to somatic afferent and visceral afferent fibers, visceral efferent as well."

An excellent balance has been maintained between the facts of observation on the one hand and the theories of interpretation on the other hand. The book is rich in explanations of the probable significance of the points of difference in the patterns of various vertebrate systems. The continual attempt on the part of the authors to analyze the "why" of nervous organization from both the ontogenetic and phylogenetic standpoints makes a fascinating account. The first chapter, for example, is made especially interesting by the presentation of the "structural laws of the nervous system." This includes "the principles of neurobiotaxis" with its important implications for the arrangements of nerve cells, the factors responsible for "monoaxonism and polydendritism," and the functional activities and associations that underlie "selectivity in the connections of neurons." These are points of fundamental significance. A consideration of them forms a fine introduction to the following chapters in which are given the neuroanatomical details.

Chapter V which deals with the effectory system ends with an excellent review of the variations in position of the efferent nuclei of the cranial nerves in the various classes of vertebrates. It is pointed out that these changes in position are associated with the functional development of other centers within the nervous system. Thus, "the caudal migration of the neurons constituting the main efferent nuclei of the facial undoubtedly is an expression of the tendency of this center to approach the gustatory centers. This migration is least marked in those animals in which gustatory sensation is poorly developed, as in cyclostomes and especially in birds." It is pointed out also that marked selectivity is shown in migrations of this type. "Thus an increase in the medial longitudinal fasciculus leads to a migration of the neurons of the abducens nucleus into its vicinity, since the impulses which it carries are of major importance in the functioning of the abducens nerve. That impulses over the medial longitudinal fasciculus do not affect the nucleus of the facial nerve in a similar manner is due to the fact that the impulses carried by this fasciculus are not related primarily to the functional activity of the facial nerve . . . Thus the primary law of neurobiotaxis is expressed best by saying that the position of a nucleus is determined by those fiber systems which are correlated with it and over which the major number of stimuli are conducted to it."

Chapter X contains an illuminating account of "phylogenetic and functional significance of myelogenetic studies of the cortical areas," from which a few sentences may be quoted. "One of

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the important contributions which the myelogenetic studies have made is to show where the first projection tracts are to be found. The first fields becoming medullated are those in which sensory impulses are located. Of these, the first are the olfactory fields, the paleocortex and the archicortex, an indication of their early phylogenetic origin. Then follow the regions of the neocortex, which are also projection centers, such as the regio centralis, the calcarine area, and the upper temporal (particularly Heschl's) convolutions. Myelogenetic studies show very clearly the functional interrelations of the regio precentralis and the regio postcentralis. Although the precentral convolutions give rise particularly to the cortico-spinal and cortico-bulbar paths and the postcentral convolution is sensory, the two central convolutions become medullated at the same time, and the regio giganto-pyramidalis and the regio postcentralis retain a position close to each other during the course of phylogenetic development."

Also during ontogeny, "late myelinating fields are, on the whole, fields which appear late in phylogeny and are concerned chiefly, if not wholly, with higher associative functions of the brain. Thus a knowledge obtained from a study of the myelogenesis of the cortex is of great importance, not only for an understanding of its ontogenetic and phylogenetic history, but also for a comprehension of its functional activity."

The book closes with a consideration of the areas of the gray matter of the cerebral cortex and conclusions as to their functional and phylogenetic significance. The final paragraph presents a point of view worth quoting: "In concluding the discussion and summary of the cortex gray and its various functional fields, it should be emphasized that the cortex gains prominence and dominance, in phylogeny and even in ontogeny, in direct proportion to the development and differentiation of the subcortical centers. Furtherance of knowledge concerning any part of the nervous system, in the end, increases our understanding of the cortex, and an increase of the knowledge of any part of the nervous system of any vertebrate, from fishes to primates, in ultimate analysis contributes to a better understanding of the nervous system of man, with its highly differentiated neocortex gray."

For investigators and teachers in neurology this book will be of particular value. The fields of the known and the unknown are clearly indicated. The vast array of facts assembled from so many vertebrate forms makes it invaluable as a reference. The fertile, explanatory generalizations offered by the authors are helpful and stimulating.

In the final sentence of the preface the authors state that they will feel well repaid for their labor in preparing the book if "it in any way aids some of those who are working in this field to a better comprehension of the problems involved in the study of the nervous system and the possibilities offered by such study." This reviewer has already found new facts and ideas presented which are of aid to him in a related field of investigation, and ventures the prediction that other readers will have a similar experience.

This book of Kappers, Huber and Crosby may well be compared with the great book of Cajal (1928) on degeneration and regeneration of the nervous system and with the stimulating volumes edited by Penfield (1932) on the cytology and cellular pathology of the nervous system. All three represent distinctive landmarks in the progress of neurological work.

C. C. Speidel

HOW ANIMALS DEVELOP. Waddington, C. H. 13 + 128 pp. Illustrated. W. W. Norton. 1936. $2.00.

To those of us who have been asked in recent years to suggest readings in the physiology of development for the elementary student or the layman, Waddington's "How Animals Develop" is very welcome. In the past we have had the little volume of DeBeer which is well written, concise, and contains a very good list of general references as well as more specific citations for supplementary reading. Recently the subject has been more completely reviewed for the more advanced student by Huxley and DeBeer. Waddington, however, has kept his presentation on the more elementary level. Without attempting to discuss different views as to the causal relationships responsible for divergence in the course of individual development, the author has stated in a clear and interesting way his interpretation of the processes involved and has outlined the experimental approaches which have proved of value in their analysis. He has drawn his material from both of the larger divisions of the animal kingdom though it is to be regreted that he has not included some of the material on the annelids and the molluscs. The echinoderms are mentioned with some of the experiments of Hörstadius; the insects with the experiments of Seidel; mosaic development is outlined with references to the tunicates. The remainder is concerned with the development of the vertebrates. There are chapters on the "Organization Center," differentiation, and pattern. The final section is on "Final Adjustments" in terms of food, respiration, and excretion; growth; function; the nervous system; sexuality; and genetics. The book would be of added value if it contained a list of well selected references for collateral reading, and a glossary. The latter would have enabled the writer to be slightly more exact in the description of material.

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THE WOODS HOLE LOG

WOODS HOLE NEWS

Frances McInnes

Many of the summer residents of Woods Hole are interested in what has happened here during the past winter; we therefore think it appropriate to inform them of the more important events.

There were three fires of consequence during the winter months, the most outstanding being the home of Mr. M. C. Draper at Penzance Point. The fire, with a damage estimated at $35,000, completely destroyed the house. Plans for rebuilding were started immediately after the fire.

The home of R. C. Hathaway at Gunning Point was destroyed by fire last December. The damage was estimated at $10,000.

Shortly after the Hathaway fire, the home of L. C. Wittigg on Vineyard Sound Avenue was destroyed, the damage being $10,000.

Two new fire alarm boxes have been installed in Woods Hole. One is located on Nobska Road opposite the George Wright estate; the other at the corner of Glendon Road and the State Highway.

Experts claim that Woods Hole suffered its severest winter in years. The frost, in places, reached to a depth of four feet; water mains were frozen and had to be thawed by means of electricity. Temperature was recorded as low as 10 degrees below zero.

The steam boat channel through the Hole was frozen for nearly a month, and it was necessary for the steamer to go up the Sound by way of Quick's Hole. The Island of Nantucket was isolated for several weeks; all provisions and mail were transported by plane.

The extreme cold weather made it impossible for sea fowl to secure food, causing great numbers to perish along the shores.

A sudden squall caused a boat—chartered to Dr. Douglas Marsland and owned by Oscar Hilton—to capsize in Little Harbor last week. Dr. Marsland was accompanied by Mrs. Marsland and two friends. Captain Walter Dow of the *Gosling* came to the rescue. The estimated damage was "a good ducking."

The Woods Hole team of the Twilight League is fighting for the lead with Falmouth. A win by Falmouth Sunday gave them a slight advantage.

SUMMER COLONY NEWS

Elizabeth Thornton

The Yacht Club has announced a change in rates for this season. Formerly five dolla.s a person, the dues are now twenty-five dollars for a family of not more than four with a five dollar charge for each additional member of the family. Mr. Albert Borden, Jr., is in charge of the club for the summer. Miss Peggy Clark, who is a student at the Yale Drama School, plans to do the club's secretarial work.

The new clubhouse will be used for the first time this season. Furniture which has already been ordered is expected to arrive soon. The club has put out its floats and it plans to have a new flagpole for the end of the pier.

Racing will start Monday. Races for small boats will be held every Monday afternoon; races for large boats every other Wednesday. The classes of boats this year will be Cape Cod knockabouts, Buzzards Bay knockabouts, and sea class cat boats.

Mr. Samuel Cahoon of Woods Hole has purchased the *Maywine*, an 18 foot Cape Cod knockabout. His daughter, Frances, will enter it in the community races.

Mr. Manton Copeland, Jr., and Mr. Preston Copeland have sailed for an extended tour of Germany. They plan to meet and travel with their brother, Mr. Frederick Copeland, who has had a fellowship in biology at the University of Munich. Dr. and Mrs. Manton Copeland and their daughter Betty are recent arrivals in Woods Hole.

Dr. and Mrs. Edward B. Meigs of Washington have opened their cottage on Gosnold Road. Mr. Wister Meigs has just received his master's degree from Princeton University. The Misses Sarah and Mary Meigs have completed their freshman year at Bryn Mawr.

Mrs. Dorothy M. Glasser and her family will not be at Woods Hole for the summer. Mr. Comstock Glasser, who has a position in Cambridge for the season, will pursue graduate work at Harvard next year. Miss Victoria Glasser has a scholarship to the Concord School of Music for the summer; she plans to enter Radcliffe in the fall.

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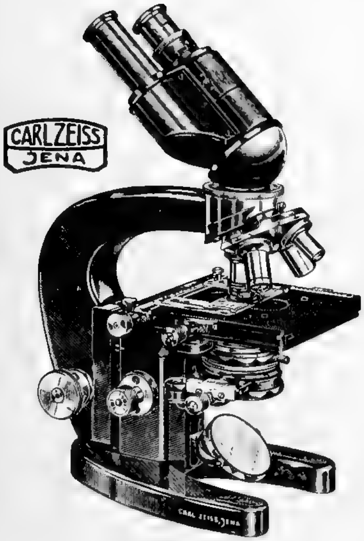

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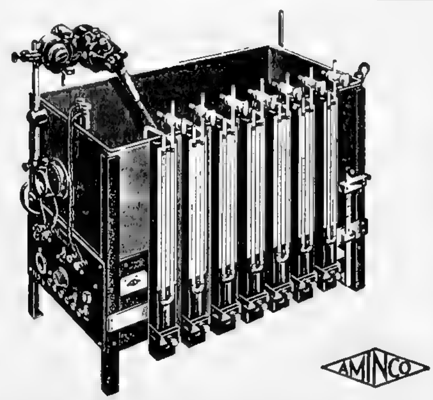

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PULMONARY VEINS, AND THEIR RELATION TO BAINBRIDGE'S REFLEX

DR. JOSÉ F. NONIDEZ

Assistant Professor of Anatomy, Cornell University Medical College

In 1915 Bainbridge[1] found that an increase in the blood pressure in the superior vena cava results in acceleration of the heart, and that this reflex is abolished after section of the vagus nerve. He concluded from his experiments that the afferent fibers which convey the pressure impulses to the nerve centers run in the vagus, but he did not express any opinion as to the location of the receptors.

In the course of studies on the innervation of the heart I found circumscribed areas of afferent nerve endings in the proximal portions of the two venae cavae and the pulmonary veins. The material used consisted of the hearts of newborn and very young rabbits, guinea pigs, and kittens, impregnated with the silver nitrate method of Cajal and sectioned serially. The advantage of using the hearts of newborn animals is obvious, since the nerve endings appear more closely placed and are not so large as in the adult. In (*Continued on page 42*)

ELECTRICAL STUDIES OF VISION IN THE LIMULUS

DR. H. KEFFER HARTLINE

Lecturer in Biophysics, University of Pennsylvania

Recent methods developed by Adrian, Bronk, and their collaborators for recording the electrical activity of single nerve fibers has made possible a study of single sensory cells concerned with vision. These elementary photoreceptor units, on being stimulated by light, respond by discharging a series of impulses in their nerve fibers; the resulting sensory message is similar in all respects to that obtained from other single sensory cells such as those of pressure, taste, etc.

A study of the response of a single visual sense-cell from the lateral eye of Limulus shows that it undergoes adaptation when the illumination is prolonged; that it can mediate intensity differences; and that the processes of light and dark adaptation may be ascribed to it. In its quantitative behavior it may be shown that Weber's law is an attribute of the single visual sense-cell, and that the reciprocity relation between intensity and duration is also to be described in terms of the behavior of these

M. B. L. Calendar

TUESDAY, July 14, 8:00 P. M.
Seminar:

Dr. A. K. Parpart: "Permeability of the Erythrocytes of the Ground-hog."

Dr. S. C. Brooks: "Ions in Sap and Protoplasm of Valonia."

Dr. H. Burr Steinbach: "Effect of Salts in the Injury Potentials of Frogs' Muscle."

Mr. Daniel Mazia and Dr. Jean M. Clark: "Free Calcium in the Action of Stimulating Agents on Elodea Cells."

Dr. Kurt Stern and Dr. Delafield DuBois: "A Photoelectric Method for Recording Fast Chemical Reactions."

FRIDAY, July 17, 8:00 P. M.
Lecture:

Prof. G. H. Parker: "Neurohumors as the Means of Animal Color Changes."

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sensory units. Likewise the relative brightness of lights of various wave lengths is determined by the efficiency with which they are absorbed by the photochemical system of the single visual sense-cell. Discrimination of color, however, in those animals which possess this faculty, probably requires an additional mechanism.

It is possible to show that visual sense-cells from even as primitive an eye as that of limulus, differ sufficiently from one another to have a true differential sensitivity to wave length. An adequate central mechanism for integrating the nerve activity from an aggregate of sensory cells is, of course, necessary for explaining color vision on the basis of such differential sensitivity.

Some of the processes which are concerned with integration of sensory information may be studied by recording the discharge of impulses in single optic nerve fibers of the vertebrate retina. For the vertebrate retina, in addition to its layer of receptor cells (rods and cones) possesses extensive ganglionic elements (synaptic layer, bipolar cells, horizontal cells, ganglion cells) and its optic nerve fibers show a diversity in their response to light which probably is to be attributed to this complex nervous organization. Thus the frog retina, in addition to possessing fibers which discharge continuously in response to maintained illumination, also contain fibers which signal only an increase and others which respond only to a decrease in the level of illumination. Such fibers are possibly of importance in the detection of movement of the visual pattern.

Rhythmic firing of single ganglion cells in the frog's retina, and the synchronization of such rhythmic bursts in several fibers is additional evidence that the vertebrate retina possesses properties common to other nerve centers.

(This article is based upon a seminar report given at the Marine Biological Laboratory on July 7.)

DISCUSSION OF PAPER OF DR. HARTLINE

Dr. R. W. Gerard
Associate Professor of Physiology, University of Chicago

Dr. Hartline has succeeded admirably in summarizing his extensive experimental analysis of vertebrate and invertebrate retinae. Little can be added, in a brief comment, to this mass of material. One point of special interest, both to central nervous physiology and to the problem of excitation in general, is that in the frog certain nerve fibers discharge in the dark and are quiescent in light. Assuming similar relations in the cat, this is in harmony with the observation that a fairly continuous discharge in the optic tract can be promptly and completely abolished by shining light in the eyes.

As Dr. Hartline pointed out, the existence of such "dark active" fibers in the frog eye, as contrasted to that of limulus, might document convergence of inhibitory impulses on the ganglion cells from which they originate, such cells being absent in limulus. The similar presence, in the pectin eye, of a discharge on turning off the light throws doubt, however, on this interpretation. In fact, there is probably nothing more surprising in stimulation of a photo-receptor by a decrease in light intensely than in its stimulation by an increase.

Presumably the cell is maintained in some equilibrium condition by a balance in rate of a series of chemical reactions, partially opposed, partially seriatim. A sudden increase of photo-chemical break-down would shift the chemical balance in one direction, a sudden decrease would shift it in the other. There is no reason for expecting one and not the other change to set off the additional physical the chemical events which constitute a physiological response. It may further be possible to relate to such a view those cells which continue a regular discharge during light, and even the spontaneous discharging of neurons in other portions of the nervous system which are stopped by afferent stimulation. In these cases also, one may think of an equilibrium level displaced to a new one, in one case towards, in the other from the "discharging position," by the maintained shift in environmental conditions. Dr. Hartline is to be congratulated on his skillful analysis by difficult methods of many important problems associated with vision and general sensory physiology.

PULMONARY VEINS, AND THEIR RELATION TO BAINBRIDGE'S REFLEX

(Continued from page 41)

the latter a single arborization would probably be contained in several sections, and its cut branches might be interpreted as portions of a plexus of independent nerve fibers.

The receptor areas of the venae cavae and the pulmonary veins occur in that portion of the vein wall which has lost its smooth muscle fibers, the latter being replaced by an extension of the myocardium represented by anastomosing striated muscle fibers. The receptors are of two types, namely, subendothelial nerve endings and perimuscular arborizations. In the superior and inferior venae cavae the latter type occurs at the junction of the vessel with the atrium, and extends somewhat into the atrial musculature. In

[1] Bainbridge, F. A. The influence of venous filling upon the rate of the heart. Jour. of Physiol., Vol. 50, p. 65, 1915.

the pulmonary veins the perimuscular receptors occur throughout the wall of the vein, which is occupied by anastromosing muscular trabeculæ. The nerve endings of the two types mentioned are more elaborate in the cat than in the rabbit and guinea pig.

The subendothelial receptors are either small and rather compact, or large and diffuse. The latter arise chiefly from large myelinated fibers, which course in branches of the vagus carrying numerous preganglionic fibers. The outstanding characteristic of the subendothelial receptors is the proximity of their branches to the endothelium. The branches end as minute rings and small reticulated swellings which may be in actual contact with the endothelial elements. Their morphology is essentially identical with that of the pressure receptors located in the carotid sinus and the areas of termination of the aortic (depressor) nerves in the arch of the aorta and the right subclavian artery, respectively.

The perimuscular receptors somewhat resemble the proprioceptive nerve endings found in skeletal muscle, i.e. the so-called muscle spindles. The branches of the arborization in this case are wound around the cardiac muscle fibers in a way suggesting their mechanical stimulation when the latter contract. The size of these fibers and the extraordinary complexity of the arborizations clearly indicate their afferent nature.

My interpretation of the subendothelial nerve endings is that this type of arborizations represents pressure receptors which are stimulated mechanically during the stretching of the vein wall caused by a rise in intravenous pressure. They do not differ in any essential point from the other known pressure receptors, except that they are placed close to the endothelium, whereas in the carotid and the aorta the receptors are located in the externa or adventitia. However, this difference may be due to the loss of the smooth muscle fibers of the media of the veins as they enter the heart. The position of the subendothelial nerve endings suggests that they may be excited by a slight rise in the intravenous pressure. If this interpretation can be experimentally confirmed the anatomical basis for Bainbridge's reflex will have been found. This reflex is in a way antagonistic to the reflex elicited by stimulation of the pressure receptors of the carotid and the aorta, for in this case the blood pressure falls as a result of vaso-dilatation in other areas of the body, and the heart beat is correspondingly retarded. An increase in the blood pressure due to acceleration of the heart would thus be effectively prevented, and this is in accordance with the findings of Bainbridge.

In regard to the perimuscular nerve endings the interpretation of their function is more difficult. As far as I am aware nerve endings of this type have not been described in the heart. In a recent brief article McDowall[2] reports the presence in cats of a branch of the vagus which if stimulated causes a rise of pressure, although stimulation of the central end of the main trunk of the vagus at this level causes typical depression. Whether the perimuscular nerve endings are involved in this reflex is an open question. At the present time any attempt to explain the function of the nerve endings under consideration would be speculative. It is to be hoped that the physiologists will be able to devise methods to test them differentially, for their function may be different from the activity of the subendothelial arborizations, which are clearly of the pressoreceptor type.

[2] McDowall, R. J. S. A cardio-pressor nerve. Proc. Phys. Soc., Jour. of Physiol., Vol. 83, p. 37, 1935.

(This article is based upon a seminar report given at the Marine Biological Laboratory on July 7).

DISCUSSION OF PAPER OF DR. NONIDEZ

Dr. Frank H. J. Figge
Associate Professor of Anatomy, University of Maryland

The very concise and definite statements of the findings of Dr. Nonidez call for little discussion. While the interpretation or inference that the observed receptor areas are involved in the Bainbridge reflex appears very logical and highly probable, it must be remembered, as pointed out by Dr. Nonidez, that this remains to be confirmed experimentally. The observations of Dr. Nonidez thus creates a problem for the physiologist, i.e., that of isolating the specific vagus fibers that supply these areas to see if stimulation of these give rise to the Bainbridge reflex or cardiac acceleration; and to see if they transmit impulses to the cardio-accelerator center when stimulated by increased pressure. The problem then, again, becomes an anatomical one, namely, that of deter-

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

mining the distribution of the fibers that mediate the Bainbridge reflex by degeneration experiments to see if they are distributed to the areas described by Dr. Nonidez. The observations of Dr. Nonidez, in addition to their value as contributions and a stimulus to further work, demonstrate two well-known facts, one of which is all too frequently overlooked: first that anatomy and physiology are closely inter-dependent, and that a discovery in anatomy calls for experimental substantiation in physiology, and vice versa, before it is established upon a firm basis; the second fact is that research in pure anatomy is not bankrupt for one who has the superb technical skill and keen powers of observation and correlation of Dr. Nonidez.

THE DESCRIPTION OF AN OXIDATIVE PROCESS MAINTAINING THE FREQUENCY OF THE HEART BEAT

DR. KENNETH C. FISHER

Demonstrator, Experimental Biology, University of Toronto

The rhythmic activity of the embryonic fish heart persists as a physiological process which is entirely supported by reserves of food in the egg. Oxidation yields the necessary energy, but there is a long series of steps between the supply of O_2 and food and the rhythmic activity. This series can be differentiated by the use of CN and CO which arrest oxidation by specifically eliminating the *atmungsferment* from active participation.

The frequency of the heart rhythm can be properly taken as a measure of the velocity of the chemical reactions which provide it with energy, and the time required for a decrease in frequency is the time required for the exhaustion of an essential reactant. When O_2 is entirely removed, the heart rhythm decreases slowly over several hours. When the application of oxidative energy is hindered by CN or CO the decrease in rhythm is rapid, indicating that only a small reserve exists between the reaction poisoned by CO and CN and the maintenance of the normal rhythm.

Upon subjection to CN the frequency of the heart falls below normal, but it does so only after intervals which grow longer as the concentration of the poison is lowered. In most experiments the lag is taken up by a preliminary acceleration which, it was felt, was due to nervous activity. That this is the case in Fundulus embryos seems establisred fairly satisfactorily, for embryos without a functional vagus do not exhibit the acceleration, while those which have a functional vagus usually do.

When the lag period has ended, the frequency of the heart falls in an orderly fashion to about 60% of the normal, where it may be maintained. At any point during the fall the frequency may be obtained with considerable accuracy from the expression:

$$Kt = \ln \frac{Rp}{Rt}$$

"Rp" is the total amount the frequency is to fall, "Rt" the amount the frequency has yet to fall at time "t," and "K" a constant. The fit of this equation to the points obtained by averaging individual experiments is extremely good. Besides representing the time course of a unimolecular reaction this formula likewise represents the progress of diffusion. If the shape of the observed curves is determined by the rate of diffusion, then the time required to reach the asymptotic level should be related to the CN concentration since the rate of diffusion is proportional to the concentration gradient. From the data obtained it appears that the presence of some such concentration as N/12000 in the organism causes maximum reversible inhibition. Using this formula an estimate may be made of the time required for the CN concentration to become N/12000 in the embryos, starting with various concentrations outside. For N/10000 the calculated time is close to the observed 20-30 minutes for the fall to the asymptotic level, but for N/1000 the calculated time is far shorter than that observed so that this criterion for the operation of diffusion is not fulfilled. It seems probable, therefore, that this relation describes the behavior of the step from *atmungsferment* to beat when the *atmungsferment* is no longer able to take part in the carriage of O_2 or electrons.

(This article is based upon a seminar report given at the Marine Biological Laboratory on June 30.)

OXIDATION-REDUCTION POTENTIALS AND POTENTIOMETRIC DETERMINATION OF ASCORBIC ACID

DR. ERIC G. BALL

Associate in Physiological Chemistry, Johns Hopkins Medical School

One of the outstanding chemical properties of ascorbic acid (Vitamin C) is its reducing ability. Whether this property is of biological significance is by no means clear though some evidence has accumulated to indicate that such reducing properties may be important in biological processes.

One step towards clarification of this issue would be the determination of the oxidation-reduction potential of the system of which ascorbic acid is the reductant.

Attempts to measure the potential of this system by the usual technique were unsuccessful. The failure of the system to come rapidly into equilibrium with noble metal electrodes indicated that it was electromotively inactive in comparison to a system such as methylene blue. However, by employing a system such as the latter to act as a mediator between the electrode and the ascorbic acid system it was found possible to record indirectly the potentials of the ascorbic acid system. The system acting as a mediator must of course be present in amounts that are small relative to the ascorbic acid system so that the potential recorded will be predominantly determined by ascorbic acid and its oxidant. With such a technique it was possible to obtain titration curves in the acid range that left no doubt as to the true reversibility of this system. In neutral or alkaline solutions further difficulties are introduced by the decomposition of the oxidant of ascorbic acid which, starting at about pH 5.0, becomes increasingly rapid as the pH rises. It is possible to obtain values to a pH of about 8.0 by extrapolation of the time potential curves. Beyond this point the rate of decomposition is more rapid than the response of the electrodes. At pH 7.4 and 38°C. the half life of the oxidant of ascorbic acid is about 2 minutes. It appears doubtful that with such a rapid irreversible decomposition of the oxidant this system can act as a cyclic catalyst in the respiratory mechanism of the living organism. Indeed if it does the process must be a comparatively rapid one or else some mechanism to stabilize the oxidant is involved. The E'_0 value of the system at pH 7.4 and 30°C. is + 0.045 v. This value is quite negative to that of the epinephrine system under the same conditions. In a previous paper it was shown that the oxidant of epinephrine was an extremely unstable compound with a half life of 0.06 seconds. This means that epinephrine must be held in a reducing environment if it is to be protected from a destructive oxidation. Ascorbic acid can produce a reducing environment of the required intensity for this purpose, and the high content of this substance in the adrenals is suggestive.

The use of a mediator to obtain titration curves of ascorbic acid suggested the possibility of using this method in assaying this compound in natural products. This has been accomplished with orange juice buffered with acetate at pH 4.6 and using thionine as a mediator. The values obtained agreed within 0.5 mv. with those predictable for pure ascorbic acid and so indicate that the assay by this method is quite specific for ascorbic acid alone. The results moreover show that only the reductant is present in orange juice since no distortion of the curve is observed as would be the case were oxidant also a normal constituent. The total amount of ascorbic acid present in orange juice as determined by this method was about 60 mg. per 100 ml. This value agrees well with that determined concordantly by the indophenol titration. This fact should not however be interpreted to mean that the indophenol method is specific for ascorbic acid when applied to other natural products. The application of the titration method to other material is desirable for this reason.

(This article is based upon a seminar report given at the Marine Biological Laboratory on June 30.)

EXTINCTION OF REFLEX RESPONSES IN THE RAT

DR. C. LADD PROSSER

Assistant Professor of Physiology, Clark University

Most of the known changes in excitability of reflex centers, such as facilitation and inhibition, last for only a fraction of a second. Yet there are many behavioral observations, such as Pavlov's conditioning and extinction, which indicate long-lasting modifications, and occur with stimulation at frequencies much lower than those ordinarily used physiologically.

The effect upon reflex responses of stimuli applied at intervals of 10 to 15 seconds was studied. The following reflexes were observed: in normal rats, leg withdrawal in response to a click, probably a collicular reflex, and in chronic spinal rats, tail and leg responses to mechanical stimulation of the tail, electrical stimulation of the tail and of the central end of the saphenous nerve. Muscle potentials were detected with concentric needle electrodes.

As the stimuli were repeated each of the responses diminished in size in that the number of active motor units decreased and the after-discharge was shortened. There was, however, no change in latensy of any unit before it ceased to respond. Ultimately there was no response. This "extinction" persisted for many minutes if no more stimuli were given. Further stimuli strengthened the effect. If, after extinction, general excitation occurred, as by a light flashed in front of the animal (in the auditory reflexes), or by a pinch on the foot (in the spinal reflexes), the animal responded to the next extinguishing stimulus. In Pavlov's terminology "disinhibition"

had destroyed the effect of the "extinction." The responses after disinhibition were similar to those before extinction and could be extinguished again.

That these phenomena are not localized in the sense organs is shown by the fact that extinction occurs when a sensory nerve is stimulated directly. Also, no sensory adaptation has been described for such low frequencies of stimulation as once every 10-15 seconds.

If, after extinction of a spinal reflex to mechanical stimulation of the tail, the stimulator was moved 1-2 mm. so that new sensory endings were excited, a response occurred in some of the same motor units. This shows that the extinction effect is antecedent to the final motoneurone, presumably at some of the internuncial synapses. We were unable to extinguish a spinal knee jerk in which probably no internuncial neurones are involved.

The time relations make it impossible for the extinction to be inhibition in the Sherringtonian sense, or equilibration. That it is not fatigue in the sense of accumulation of waste products or depletion of metabolites is shown by the fact that it is more difficult to extinguish a response to a strong than to a weak stimulus. Further, such fatigue is inconceivable in a preparation with normal circulation at such low stimulation frequencies; if fatigue did occur it is unlikely that it would be wiped out by general excitation. Rather, it seems that these widely separated stimuli lower the excitability at internuncial synapses in a relatively lasting manner, and that this effect can be upset by general excitation.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 7.)

NERVE CELLS WITHOUT CENTRAL PROCESSES IN THE FOURTH SPINAL GANGLION OF THE FROG

DR. ALFRED M. LUCAS

Associate Professor of Zoology, Iowa State College

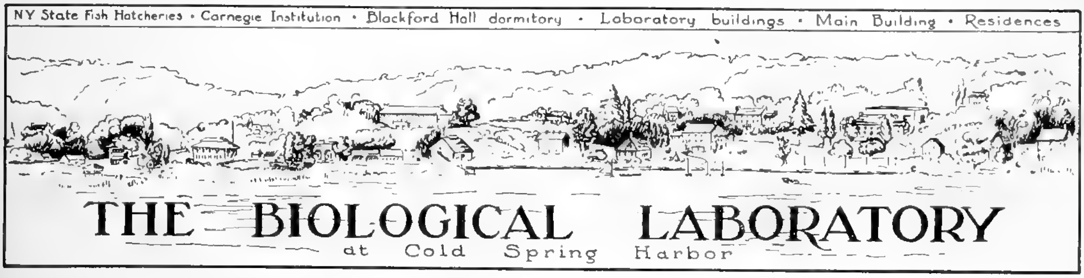
Serial sections of the 4th spinal nerve of the bullfrog which included the roots, spinal ganglion, dorsal rami, spinal nerve trunk, ventral ramus, communicating ramus, sympathetic trunk anterior to the 4th nerve and the celiac nerve which were stained in toto with osmic and silver methods, furnished fiber counts in the regions mentioned. The number of myelinated fibers found in the two roots was 667 and about 259 of these passed to the dorsal rami leaving 408 fibers for the spinal nerve, but distal to the ganglion 950 myelinated fibers were counted. Total fiber counts from silver preparations revealed 1372 in the dorsal root, 648 in the ventral root and 883 subtracted passing to the dorsal ramus left 1137 for the spinal nerve. Actual count of the spinal nerve showed 5277 fibers. The additional fibers arose from the dorsal root ganglion in which was located 5220 cells. Axons from these cells were small myelinated and non-myelinated types. It is concluded, therefore, that some 3500 cells are present in the spinal ganglion which lack central processes passing through the dorsal root to the cord. The distal processes pass through the communicating ramus to the celiac nerve.

Other interpretations have been considered. It is conceivable, for example, that the dorsal root fibers might branch within the ganglion and thereby produce the greater number found distal to the ganglion. Were this the case one would have some 3500 out of about 5000 cells possessing no axon processes at all. Since the animals were large full grown bullfrogs it does not seem to be a reasonable assumption. Moreover, many efforts were made to find branching fibers by means of vital staining with methylene blue. None have been found in the ganglion thus far.

It is conceivable also that during development of the neural crest the sympathetic ganglion cell mass fails to separate from the dorsal root and hence we may be studying two ganglia anatomically combined. However, were this the case, one would expect to find axons passing centrally from the sympathetic trunk to synapse with these ganglion cells. Such an arrangement would obviously necessitate more axons in the spinal nerve than nerve cells in the ganglion, but such does not seem to be the case. It is not on the basis of counts alone that such a conception is considered to be an incorrect one. Equally invalidating is the existence of a sympathetic ganglion normally placed at the junction of the sympathetic trunk and communicating ramus. The number of cells, 1099, found in this region is adequate to care for the axons in the sympathetic trunk. Finally direct evidence obtained from *intra vitam* staining with methylene blue and also careful examination of the serial sections shows that practically all the fibers in the sympathetic trunk turn distally toward the celiac ganglion. The only fibers which pass centrally are those constituting the gray ramus. These form a small bundle of very fine myelinated and non-myelinated fibers.

Finally, the reliability of the silver technique should be considered. This technique is particularly capricious when applied to frog nerves, and

(Continued on page 55)



ABSTRACTS OF SOME SYMPOSIUM PAPERS

Dr. Emil Bozler: "An Analysis of the Properties of Smooth Muscle."

It is pointed out that the contractions of smooth muscle are probably of the same nature as those of striated muscle, and that the assumption of a special mechanism for the sustained contraction of smooth muscle is unnecessary. Experiments on the action of vasodilator nerves show that they can stop or diminish the response of vasoconstrictor impulses. The discussion of the mechanical properties of smooth muscle emphasizes their plasticity. The comparison of the tension changes after stretch and during relaxation leads to the conclusion that the relaxation is a passive process, the dissipation of the elastic energy of the muscle. The energy changes of the muscle during relaxation, studies by myothermic methods, can be explained quantitatively on the basis of this assumption. According to these results the resting length shortens during the contraction. It must be assumed that a change of the arrangement of the molecules takes place during the contraction.

Dr. Kenneth S. Cole and Dr. Howard J. Curtis: "Impedance Measurements on Nerve."

Alternating current measurements on nerve and muscle have been made over a frequency range from 20 to 2,000,000 cycles, both transverse and axial to the fiber axes. The transverse measurements on muscle and stripped nerve may be interpreted on the basis of a suspension of uniform cylinders whose membranes show a polarization impedance. On the other hand, when a statistical distribution of fiber diameters and membrane capacities is assumed, measurements on frog sartorius and on frog and cat sciatic lead to static capacities of the membranes for the average fibers of 1.0 and 0.6 $\mu F/cm.^2$ respectively. The axial measurements have not been satisfactory and the lack of an adequate theoretical analysis has prevented their interpretation in both nerve and muscle. The nerve problem is further complicated by evidence of several variable impedance elements. The presence of the sheath on some nerves largely obscures the characteristics of the axons. The lack of an understanding of the impedance characteristics of nerve and muscle is a considerable handicap to the analysis of electric excitation phenomena.

NEWS NOTES FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

(July 5, 1936)

Visitors during the past week include Dr. and Mrs. W. R. Amberson, Dr. and Mrs. G. H. Bishop, Dr. D. W. Bronk, Dr. McKeen Cattell, Dr. Georges Coppeé, Dr. Hallowell Davis, Dr. A. J. Derbyshire, Dr. Alexander Forbes, Dr. Harry Grundfest, Dr. and Mrs. Rudolph Katz, Dr. G. Lehmann, Dr. and Mrs. A. M. Monnier, Dr. José Odoriz, Dr. Arturo Rosenblueth, Dr. and Mrs. C. C. Speidel, Dr. F. Toennies.

The evening lecture on July 7 was given by Mr. E. H. Anthes of the Bausch and Lomb Optical Company. The subject was "The History of the Development of the Microscope," and the lecture was illustrated with a large number of lantern slides, etc.

During the week, Bausch and Lomb held an exhibit of instruments at the Laboratory, and at the same time Clay Adams and Company exhibited apparatus and materials.

Dr. and Mrs. Harold Abramson, and their daughter Alexandra, are at the Laboratory for the the summer. Dr. Abramson will conduct his research and will teach in the general physiology course.

Dr. Bert Cunningham is spending a month continuing the experimental work he started here last summer.

Dr. Asa A. Schaeffer is again at the Laboratory for the summer. Other Temple University people with Dr. Schaeffer include Dr. Samuel Morris and Miss M. Catherine Hinchey, both of whom are carrying on their own work.

Dr. and Mrs. T. L. Smith will be here throughout the summer. Dr. Smith will continue his research and will be in charge of the stockroom.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received July 10, 1936)

Among recent arrivals at the Scripps Institution are Professor and Mrs. Leonard Loeb from the Berkeley campus of the University, who will spend about two months here; Dr. C. H. Abbott of the University of Redlands, who is again making use of the Institution's library; and Dr. and Mrs. E. H. Myers who have returned for the summer after a year at Compton Junior College. Dr. Myers is continuing his work on life histories, means of dissemination, and distribution of living foraminifera. Dr. Robert T. Young, Jr., a member of the staff of Worcester Polytecnic Institution in Massachusetts who has just received his doctor's degree at Harvard, is also spending the summer at the Scripps Institution conducting investigations on the penetration of light into sea water.

On Thursday evening of last week fifty-four members of the San Diego Dental Association met in the Institution reading room for the fourteenth of the series on dental and oral infections conducted by Dr. C. E. ZoBell in the University Extension Division in coöperation with the Southern California Dental Association. Dr. ZoBell lectured on "Oral spirochaetes with special reference to Vincent's Angina"; and Dr. R. R. Rife, of supermicroscope fame, was the guest speaker on "Recent developments in research microscopy." The discussions were illustrated with lantern slides.

Messrs. D. L. Fox, M. W. Johnson, and C. E. ZoBell returned last week from their journey to Seattle to attend the meetings of the Pacific Division of the American Association for the Advancement of Science and other organizations, including the Oceanographic Society of the Pacific. Members of the Scripps Institution staff presented twelve scientific contributions, most of them before the Oceanographic Society.

Mr. Bradley T. Scheer, a recent Bachelor of Science from the California Institute of Technology, arrived June 30 to become research assistant in psysiology to Dr. D. L. Fox of the Scripps Institution.

Mr. Chesney R. Moe and Mr. Dudley H. Robinson, of the faculty at San Diego State College, are registered as graduate students for the summer at the Scripps Institution of Oceanography, and are studying the carotenoid pigments of marine organisms with Dr. D. L. Fox.

Dr. Martin Johnson left La Jolla the afternoon of July 5 to join the U. S. Coast and Geodetic Survey Steamer *Guide* at Oakland to take part in oceanographic work off Cape Mendocino. While aboard the *Guide* Dr. Johnson will get records of surface and subsurface temperatures, collect water samples for chemical study, and surface and subsurface plankton samples.

The boat *Scripps*, in charge of Dr. Roger Revelle, returned on July 1 from a week's trip of about 400 miles to San Clemente Island, Cortes Bank, and to San Nicolas, the most distant and least visited of the Channel Islands. The trip was primarily for the purpose of obtaining core samples of the sediments on the sea bottom, and thirty cores were collected ranging in length up to twenty inches. In addition, fourteen samples from the surface of the bottom muds were procured and some surface water temperatures and salinities were observed. In a one-mile deep depression called San Clemente Trough, south of San Clemente Island, water samples and temperatures were obtained for both chemical and bacteriological investigations in the Institution's laboratories.

STAFF MEETINGS AT THE OCEANOGRAPHIC INSTITUTION

At eight o'clock on July 2, Mr. Henry C. Stetson of Harvard University delivered the first paper of the weekly staff meetings on "Submarine Canyons." These valleys are among the most puzzling problems confronting the geologist today and as yet no theories have been advanced which satisfactorily explain their presence.

A few of these deep valleys at the continental margin were discovered about sixty years ago by soundings made by the United States Coast and Geodetic Survey. These surveys were continued sporadically up to the last six or seven years when they were summarily accelerated by the use of the fathometer. The knowledge of the shape of these canyons can therefore be attributed to the excellent work of the Government Survey boats.

The submarine canyons are quite comparable in depth to the largest canyons formed on land such as the Grand Canyon of the Colorado River as the contour maps of the oceanic canyons also bring this out quite clearly. Mr. Stetson divided the canyons into two classes: those formed off the mouths of master rivers which have a trench leading across the continental shelf and short, steep-sided trenches which just cut its edge. Examples of the former, to mention but a few, are found near the mouths of the Hudson, Indus and Congo Rivers while the latter are present all over the world but are best known on the eastern Atlantic coast. The floors of these valleys range from about 8,000 to 10,000 feet below the present sea level. The valleys off the Pacific coast are deeper and come closer to the shore than do those along our coast.

In an attempt to date the canyons by means of fossiliferous rock fragments dredged from their walls the *Atlantis* has made two trips to the canyons off our eastern coast. A special type of dredge of heavy contruction was used in obtaining this material. The fossils have placed the age of these particular canyons not later than the upper Tertiary and the extreme youth of these major features of topography is one of the most startling things about them. If they are stream cut, we must postulate a rising of the land or a sinking of sea level of the order of 10,000 feet, and there is no geological evidence that such an event could have taken place in the comparatively short time that has elapsed since the upper Tertiary.

In an effort to escape from these difficulties there have been several theories formulated as to the precise origin of these deep sea valleys, the most prominent being those of R. A. Daly and of F. P. Shepard. Mr. Stetson said that there was as yet not enough data to warrant the complete acceptance of any one of these causes of origin.

Donald Zinn.

PHYSIOLOGY CLASS NOTES

One can not help but observe that the physiology course at Woods Hole attracts a varied lot of people. Probably the way the course is planned is responsible for it, as the students may choose four out of a dozen widely varying problems on which to spend their time and these problems are quite diverse. Each section of the course is under the direction of an authority in that particular field so likewise the staff are quite diverse in their interests. We thought we would like to know more about the interests and hobbies of the group so we plan to do a little prying from time to time.

Dr. Laurence Irving who is in charge of the course for the second summer has been an instructor in the course since 1931. He gives the section on acid-base equilibrium and CO_2 capacity of tissues and sea water and keeps the Van Slykes, Haldanes and students busy far into the night. After obtaining his Ph.D. from Stanford he went to Germany as a National Research Council fellow in biology. Two years later he went to the University of Toronto where he is now associate professor of biology. His main interests have been in the fields of acid-base balance and the chemistry of muscle, but at present he is working on the respiratory control and physiological adjustments of diving animals. It is said that he is a very good diver himself, but that in the winter he takes to skis.

Dr. C. Ladd Prosser who directs the sections on the nervous system is instructor in the department of biology at Clark University. He is an authority on invertebrate nerve physiology and spends his spare time tapping the nerve impulses in the tail of the crawfish. We understand however that since coming to Woods Hole he has depleted the surrounding waters of dogfish.

The work on tissue respiration and CO_2 transport is in the charge of Dr. J. K. W. Ferguson who has been at the University of Western Ontario. Next year he is taking up his residence in the United States and will be at the Ohio State University. Dr. Ferguson is a particularly ardent CO_2 enthusiast having spent a year with Roughton at Cambridge but he is able to tear himself away for canoe trips now and then.

The class, as might be expected, is a motley crew with a wide variety of interests and training. In it there are undergraduates and medical students, a physician, several teachers, a bacteriologist and at least two singers with operatic inclinations. But in spite of this diversity we get along (we think) quite well. No major discoveries have been made but Miss Magalhaes and Mr. Lilly have found that the dogfish writes a very beautiful fin. By attaching a writing point to a dorsal fin and stimulating parts of the optic lobes and cerebellum they got some very nice signatures (and exterminated the dogfish as noted above). The laboratory on Wednesday underwent a very sudden transformation,—kymographs disappeared, the Warburgs became silent and into their places popped a flock of brightly colored perfusion bottles. These are being used in permeability and absorption experiments under the kindly and watchful eyes of Dr. Höber.

Elizabeth Magers

BOTANY CLASS NOTES

On Monday, July 7, the second botany seminar of the season was held in the botany laboratory. Dr. Francis Drouet gave an illustrated talk on his recent trip to Brazil. He had been invited by the Brazilian government to collect vascular plants and aquatic algae. He accompanied the Brazilian Fish Commission which was repopulating the lakes of northeastern Brazil with fish. Most of Dr. Drouet's collecting was done in this region, around the towns of Belem and Fortaleza. His pictures were of the towns he visited—most of which consisted of only a shed and a dock. There were some very fine pictures of Belem and Fortaleza, which Dr. Drouet classified as "up and coming" little cities. After the seminar tea was served and Dr. Drouet brought out his photographs for closer perusal.

Martha Thurlow

EMBRYOLOGY CLASS NOTES

The holiday picnic of the embryology class to Tarpaulin Cove came at the end of a busy week. From Monday until Saturday, students spent long days attending lectures and laboratory instruction in Tubellaria regeneration and experimental methods in work on echinoderms. Consequently the beach party of Saturday, the "Fourth," was a healthy diversion.

The week began under Dr. Barth's direction, with the study of "plant-animals," Obelia, Bongainvillia, and Tubularia. Certain theories regarding the origin of the classification of these as animals were humorously advanced by students from Amherst and Wesleyan. Taxonomists in the class discovered numerous crustacians and molluscs among the stem-like hydrocauli and hydrorhizae of the zoophytes. These included the "gate-swinging" *Aeginella longicornis* and *Aealis papillosa.*

The work continued under Dr. Schotté. The advantage of summer study at Woods Hole, where contact can be made with the eminent workers in biology, was fully realized on Thursday. In the morning Dr. Hörstadius reported to a classroom crowded with visitors upon his extensive experimental studies with echinoderms. E. B. Wilson remarked as he left after the lecture "His is the most brilliant work ever done in experimental embryology." In the afternoon, the class had the privilege of meeting Mrs. Harvey (of Princeton) who explained her use of the high-speed centrifuge and centrifuge-microscope in the production of merogomes. Certainly some of the students received immediate inspiration from such contact with these experimenters; perhaps that explains the night watchman's report that the embryology laboratory was occupied after midnight on Thursday night and the night before the picnic.

The first report of the presence in this class of a Jules Verne of embryology came during the Tarpaulin Cove expedition which ended the week. A student explained that by combining artificial parthenogenetic treatment of merogomes with some ultramicrurgy technique ("soon to be perfected") we may realize human production of animals with any desired heredity.

The entertainment, Saturday, consisted of "leap Rana," "Arthropoda races," and baseball. The baseball game was played under Mid-Western rules supplied by the protozoologist guest who owned the bat. There are still some technical questions (in ecclesiastical circles) which the rules left undecided. This game was designated as a practice game for the challenge encounter with the physiology team. It was proposed that the protozoologist lend his bat and rules for that game also.

It may be mentioned that there were a few die-hards who would not forget their work for an afternoon, but preferred collecting protozoans to playing baseball.

"Is it Arbacia?" was a game extemporaneously devised by Captain Klamer and his rowboat crew who decided upon a hurried investigation just as the motor of the *Winifred* was started for the songful home voyage.

Guests of the class included its professors, representatives from the physiology and protozoology classes, Dr. Josel Szepsenwol (a Rockefeller Foundation Fellow), Mr. Dick Forman (an investigator under Dr. Schotté), and the Misses Margaret and Janet Rae (visiting Miss Froelich of the embryology class).

Donald Bauer

PROTOZOOLOGY CLASS NOTES

After a few weeks of searching in all available waters of Woods Hole, and drawing every poor protozoan that happens to be captured, we protozoologists have turned to making slides of our prey by various techniques. We have been studying the division rate of *Uroleptis mobilis*, an organism to which we cater by preparing fresh medium, and counting the individuals in each line every day. But alas for Uroleptis, for his marvelous and most intimate life is closely scrutinized and translated to numbers and graphs on a card. We continue to study, draw and classify more protozoa. Experiments in cultural methods are being conducted and deep concern is expressed when one's culture dies off. But nothing can equal the sadness that prevails when a Uroleptis dies.

Along with full days of serious work, we manage to have a grand time. The laboratory is the scene of much fun, and chief funster is the charming Miss Drumtra, whose laugh is always a welcome sound to us.

Many discussions fill our spare moments, one of the pet argumental themes being philology. It seems that the different regions of the country so well represented in our class cannot agree to the correct pronunciation of almost all words. Each region sticks to its own speech provincialisms and we exchange many idiomatic phrases.

The social life of the class consists of attending the dances, and afternoon trips to the beach. During the late evening, study is interrupted by a small tea party or refreshment of other type such as soft drinks at the soda fountain. After this, work is resumed until the day is gone.

Sydney S. Greenfield

IMPROVEMENTS OF NOTE FOR THE SEASON OF 1936 AT M. B. L.

DR. SAMUEL E. POND
Technical Director of the Marine Biological Laboratory

The x-ray suite of the Marine Biological Laboratory is receiving a new x-ray unit, designed by Dr. G. Failla of Memorial Hospital, New York City, which will permit more intensive dosage and allow greater freedom of experimental work in this field.

Two water cooled General Electric tubes operate simultaneously in this new apparatus and the living material is placed between the two targets. Both tubes in operation rectify and radiate simultaneously; therefore, the outfit requires no mechanical or "valve" rectification. Radiations at 200,000 volts and above have been planned.

All the parts of the new unit have been received at the Laboratory from the several manufacturers, and will be erected under the general direction of Dr. Failla and Mr. George D. Barclay of Mt. Vernon, New York. Mr. Morris Sander, former x-ray technician, and Mr. Robert Egeland, technician, will assist in the erection and preliminary operation.

These alterations, when complete, will make it possible to conduct radiations in a wider field than previously possible at the Marine Biological Laboratory.

The Laboratory has set aside space in Room 224 for accurate determination of hydrogen ions, in so far as equipment can be provided, in order to render greater assistance to investigators and particularly to those who may not have the proper equipment. This year the usual arrangement for quinhydrone, hydrogen gas-chain and glass electrode devices will be available. The room will be in charge of Dr. Eric G. Ball with the assistance of Dr. Chester Stock. Investigators should make arrangements with Dr. Ball for assistance in determinations.

An improvement in the room for this work is the dehumidifier made by the Bryant Heating Corporation of Cleveland. The industrial type of "silica-gel" drier has been installed for the simple drying of the room air. A blower will circulate a portion of the room air through trays of silica-gel when required (that is, under the control of a "Humidistat") so that the moisture content is kept below a certain selected amount. But simultaneously, there is another blower circulating outside air through a similar set of trays of silica-gel, washing out the collected moisture. The machine is, therefore, divided into two parts, with one half being prepared for the dehumidification while the other half is used in the process of lowering the moisture of the room air. A cooling arrangement is adjusted to keep the room temperature at about 75° F, while the moisture may be kept below a pre-selected point, probably below 40% relative humidity.

MR. A. CRESSY MORRISON CONTRIBUTES A SCHOLARSHIP

Mr. A. Cressy Morrison, former president of the American Institute of the City of New York, has given $100.00 to THE COLLECTING NET to be used for its Scholarship Fund. This gift is a direct contribution to biological research; it has been awarded to a promising student now working at the Marine Biological Laboratory.

Mr. Morrison has work and interests which cover a wide field. As a scientist, he discovered a method of separating oxygen and nitrogen in the magnetic field; as an author, he compiled the "Encyclopedia of Superstition."

Mr. Morrison is actively interested in promoting knowledge of the American policy of protection; his work in this field covers a period of many years. In 1921 he prepared an exhaustive report on labor conditions, wages, and standards of living for the United States government; he compiled a record of private loans floated in the United States from 1914 to 1927; he has made a thorough study of the enactment and administration of tariff laws since 1897.

His affiliations are so numerous that a listing of even a few of them seems long. He is executive of the Union Carbide and Carbon Corporation; member of the executive board of the National Research Council; fellow of the New York Academy of Sciences; member of the American Chemical Society; member of the American Mining Congress; secretary-treasurer 1906-1931 of the International Acetylene Association; chairman of the executive committee of the American Tariff League; vice president of the New York Electrical Society; member of the Royal Institution of Great Britain; member of the United States Chamber of Commerce; director of the Home Market Club of Boston.

In 1930 Mr. Morrison made it possible for a student to continue research work at Woods Hole by a gift of $100.00 to the fund.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Francis McInnis.

Business: Arthur C. Stirling, Amy Gamble and Boris Gorokhoff.

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MARINE LABORATORIES-SCHOLARSHIP FUND

From the Marine Biological Laboratory

July 10, 1936.

My dear Mr. Cattell:

You have on several occasions raised questions concerning the relations of the Collecting Net, which you publish, to the Marine Biological Laboratory. Of the only two possible general relations, ownership and control by the Laboratory, and complete independence, the latter alternative has been preferred and is settled. Under the conditions thus established the Laboratory maintains a most friendly interest in the Collecting Net; but it should not be expected to assume any responsibility, which cannot, in the nature of things, be divided. Nor can it on the other hand admit any responsibility on the part of the Collecting Net for the Laboratory, save as critic and friend.

The reply to the specific questions contained in your letter of July 2 is, therefore, self-evident. The Collecting Net Scholarship Association as an independent body can, of course, invite to membership any persons whom it cares to select; but the Laboratory as Corporation must decline to appoint representatives. The Laboratory would admit students or investigators supported by such scholarships on exactly the same terms as others. The purpose of the scholarships as understood by us is regarded as praiseworthy.

The organization to which you refer as "friends of the Laboratory" was known as the Biological Association. It was formed in 1894 to meet a specific emergency, and soon thereafter disbanded. The question of its revival has never been considered.

To the readers of the Collecting Net we would like to say that the Laboratory as Corporation is imbued with a trust, not only in its financial affairs, but also in its relations to the biologists of America to maintain its standards high and to foster the advance of our science. All its policies must be measured by these responsibilities. The aid of all persons of good will in this work is most highly appreciated.

Sincerely yours,

Executive Committee of the Board of Trustees of the Marine Biological Laboratory.

(*signed*) L. V. HEILBRUNN, *Secretary.*

From the Scripps Institution of Oceanography

Dear Mr. Cattell: June 29, 1936

Your letter of June 26 reached me late Saturday afternoon after everyone had left the Institution for the week-end holiday. I am in sympathy with the aim of THE COLLECTING NET to establish a number of scholarships for summer work in biology at marine stations and I should be glad to accept appointment as one of your Board of Trustees, but I think I should make it clear to you that on August 31 my term of service at the Scripps Institution terminates, and on September 1 I shall be succeeded by Prof. Harald U. Sverdrup. Sverdrup, although he is interested in biology, is not a biologist. He is primarily a geophysicist who has specialized in oceanography and meteorology. You already know from a letter that I recently wrote you that Dr. Claude E. ZoBell will be the officer in charge of the biological program at the Scripps Institution. It might be better to appoint ZoBell as one of your trustees instead of me.

However, if you care to do so, you may appoint me as one of your trustees, and I will pass the duties over to ZoBell. I have already discussed the matter with him.

With best wishes, I am

Sincerely yours,

(*signed*) T. WAYLAND VAUGHAN

From the Biological Laboratory, Cold Spring Harbor

Dear Dr. Cattell: July 2, 1936

I shall be very glad to serve on the Board of Trustees as you request. I need hardly say that any scheme to provide assistance for young investigators would have my enthusiastic support, irrespective of the Laboratory at which they wished to work.

I hope to see you at Woods Hole sometime early in August.

Yours sincerely,

(*signed*) ERIC PONDER

From the Mount Desert Is. Biological Laboratory

Dear Mr. Cattell: June 30, 1936

In reply to your letter of June 27th special delivery concerning THE COLLECTING NET Scholarship Fund, may I say that I approve of the plan and will be glad to assist in any way possible. If you think I can be of service as trustee of the fund, I shall be glad to serve. If our laboratory can have at its disposal a scholarship of about $100. per year for a deserving young man, I am sure it will be very much appreciated by us as well as by the candidate. Please advise me if there is anything I can do.

Yours sincerely,

(*signed*) WILLIAM H. COLE

ITEMS OF INTEREST

Dr. Elmer Higgins, chief of the division of inquiry of the United States Bureau of Fisheries, arrived at Woods Hole this week to spend the summer. Dr. Paul S. Galtsoff, head of the oyster pest investigation is also here for the summer.

Dr. Ralph W. Gerard, associate professor of physiology at the University of Chicago is leaving Woods Hole on Monday morning in his car for Cold Spring Harbor, where he will give a lecture on Brain Waves for the Biological Laboratory there. Soon after he will return to the University of Chicago, where he plans to devote much of his time during the summer in writing.

Dr. C. P. Lebond left Woods Hole this week for Montreal where he sailed for France on Friday.

A Hopkins beach party was held at Gansett on July 4. Approximately forty people, alumni and those now connected with the institution, attended. Fried eel was the novelty refreshment.

Dr. and Mrs. C. E. McClung and Miss Irene Corey attended the Sigma Xi Conference and Semi-Centennial in Ithaca on their way from the University of Pennsylvania to Woods Hole.

Dr. Katsuma Dan, who has been a teacher in the Marine Biological Laboratory at Misaki for the past two years, and his bride will spend the summer in research work at the Marine Biological Laboratory. Dr. Dan, son of the late Japanese financier, Baron Dan, was married on July 4 to an American scientist, Dr. Jean McNair Clark of Milford, Connecticut, who is the daughter of the late Mr. and Mrs. Laurence Alden Clark. The couple were associated in the laboratories of the University of Pennsylvania where Dr. Dan received his Ph.D. two years ago. His bride received her doctor's degree last February.

Mr. Walter R. Spoffard, assistant laboratory instructor of anatomy at Cornell University Medical School and expert falconer, was married to Miss Mary McClintock, a Cornell medical student, on June 18. Mr. Spoffard last summer held one of The Collecting Net scholarships awarded by the embryology staff of the Marine Biological Laboratory. Mr. and Mrs. Spoffard will spend the summer at Colorado College at Colorado Springs, where he will study biology and climb mountains.

Dr. and Mrs. Robert Coker have taken the Jennings cottage on Crow Hill. Dr. Coker is professor of biology at Chapel Hill and former director of the United States Bureau of Fisheries Station at Woods Hole.

INTRODUCING

Miss Maja Embden, medical student at the University of Frankfurt, Germany. Miss Embden was born in Frankfurt-am-Main in 1912. She is now a graduate student at the Johann Wolfgang Goethe University of Frankfurt-am-Main. In her studies she has worked under Professor Hohmann, Orthopedic Surgery, Professor Felix, Biochemistry, Dr. Volhard, Professor of Internal Medicine—all of the University of Frankfurt.

Miss Embden is assisting Dr. Irving for a year. She began her work at the University of Toronto shortly after her arrival in May. At Woods Hole she is working on the problem of changing blood pressure by stimulating the semi-circular canals behind the ears. In the fall Miss Embden will return to the University of Toronto where she will do research work with Dr. Irving on the total base determination in developing fish eggs.

When her year's study in America is finished next May, Miss Embden plans to return to Germany to complete her studies for her degree in medicine.

Dr. Sven Hörstadius, one of the most distinguished among the foreign workers at Woods Hole this year, is in the United States only for a short visit, mainly in connection with his work at Yale University and with the Rockefeller Foundation.

Dr. Hörstadius was born in Stockholm, Sweden, in 1898 and received his formal education there. His work in zoology, botany and chemistry at the University of Stockholm won for him the master's degree; his doctor's dissertation was concerned with the development of the embryo of echinoderms, published in German in 1928. Dr. Hörstadius has written several important manuscripts since then, one of the chief ones being a study of the embryology of the sea-urchin. At his lecture, scheduled for the evening of July 31, he will discuss these papers and the research work he has done since their publication. During the course of the summer he is also giving a series of lectures to the class in embryology, in which he will describe his work in experimental embryology in greater detail.

Before Dr. Hörstadius came to America last February as visiting professor and research worker. He had worked at Naples, Roskov, Plymouth and Utrecht besides the university of his native city.

U. R.

Dr. Emily W. Emmart of Johns Hopkins University who spent the summer of 1928 at the Marine Biological Laboratory, presented two papers at the Tenth International Congress of Medicine at Madrid during the latter part of September.

ITEMS OF INTEREST

The Death of Marquette

On Tuesday morning William George Marquette, Jr. failed to report for work at the Chemical Room of the Marine Biological Laboratory; an investigation showed that no one had positively seen him or his bicycle since noon on Monday when he ate dinner at the laboratory mess hall. Someone claimed that they had seen him bicycling northeast on the main road to Falmouth between the Quisset red light and the railroad tracks near Falmouth. Dr. Samuel E. Pond and Dr. Eric Ball organized groups of searchers which were actively functioning on Thursday, Friday, Saturday and Sunday when Marquette's body was found in the Sippiwisset woods adjoining the Beebe estate. The coroners findings stated that death had been caused on Monday or Tuesday by self-administered potassium cyanide.

A reward of $200.00 was offered for clews leading to the location of the missing botanist, financed equally by the Marine Biological Laboratory and the boy's father, who was associate professor of botany at Columbia for seven years before he became scientific director of Carl Zeiss, Inc. and vice-president of the company. The boy's bicycle was noticed on Wednesday in the woods; but the finder did not report it until Sunday morning when the notice of the reward was brought to his attention.

Dr. Caswell Grave, professor of zoology at Washington University, will also be working at the Laboratory in the Tortugas.

Dr. Shiro Tashiro of the Marine Biological Laboratory had as his guests this week the Messrs. Koba and Konishi of the Maruho Company, Osaka, Japan. Mr. Koba and Mr. Konishi are on a world tour investigating internal secretions. Their trip across the United States will be the last lap of a five months' tour of the important countries of western Europe.

The Children's School of Science and Junior Laboratory of Woods Hole opened Monday for a six weeks' course ending August 14. Children over seven may enter for first year work while that for more advanced students follows in order. The staff for this year includes Miss Virginia Mayo of Dana Hall School, Wellesley, who holds a Collecting Net Scholarship this summer Alfred D. Compton Jr. of Yale University and chief of staff Dr. Allan C. Scott, Union College, Schenectady. The courses offered are: Introduction to nature study, Water life, Insects, Animals of Woods Hole, Elementary biology and Biological methods. E. T.

There are 1385 members of the Federation of American Societies for Experimental Biology consisting of four societies: The American Physiological Society, The American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics, and The American Society for Experimental Pathology.

It is interesting to note that among this number there are only three individuals who are members of all four societies. They are: Dr. W. M. Boothby of the Mayo Clinic; William de B. MacNider, of the University of North Carolina and Dr. L. G. Rowntree, of the Philadelphia General Hospital.

Electric Torpedo Ray

A method of lighting a home and ringing a doorbell without cost was demonstrated Friday by Dr. C. Ladd Prosser, assistant professor of physiology at Clark University, at the Marine Biological Laboratory float. A large electric torpedo ray (*Tetronace Occidentalis*) brought in this week by the Bureau of Fisheries collecting boat, was tested for its electric power; two sheets of metal were placed on the ray, one on top and one underneath it, and the animal was excited to give off current by prodding at its tail. The amount of electricity which it produced was sufficent to light a small lamp and ring a door bell. Shocks were generously passed around to hardy observers.

The ray contains a store of electricity which it uses to stun or kill its prey; a human being will receive a strong electric shock from it. After the demonstration, the ray was killed and various parts of it were claimed by the biologists from the laboratory.

A smaller ray is now on exhibition in the Bureau of Fisheries aquarium along with some new specimens of shark suckers and a Portuguese man of war. E. T.

Note on the New Animal House

The new animal house of the Marine Biological Laboratory, located between the boat house and the supply building on the south shore of the Eel Pond, is fulfilling a need that has been felt by Woods Hole research workers for several years. Formerly animals were housed in the various parts of the supply department, but now the grasshoppers, turtles, frogs, guinea pigs, rabbits, and cats all live under one roof. Furthermore, the collecting crew can now tell which are the fresh water nets and which are the salt water nets, because the fresh water nets are kept in the new building!

NERVE CELLS WITHOUT CENTRAL PROCESSES IN THE FOURTH SPINAL GANGLION OF THE FROG

(Continued from page 46)

especially is this true of the dorsal root. Have some 3500 axons been overlooked when the count was made upon the dorsal root? Examination of these slides by Dr. H. A. Davenport confirms our identification of what should be counted as nerve fibers. His counts upon this material are almost identical with our own. The extremely small diameter, about one quarter of a micron, of almost three quarters of the fibers in the dorsal root raises the question whether smaller fibers may not exist whose diameter may be below the limits of microscopic visibility. If these minute visible entities represent two or three or four axons compressed together within one neurolemma sheath as has been noted by Dr. Speidel in growing peripheral nerves of the frog tadpole, then we are faced with a situation in which the separate fibers forming the group are individually below the limits of microscopic visibility, and if single fibers of this type exist separately they could not be seen. To postulate that 3500 nerve fibers were missed because they were invisible presents such complications for this and other work that one hesitates to apply such an interpretation to these data until other more promising avenues of approach have been exhausted.

In conclusion, if we assume that the counts and their interpretation are valid, then we have described the architecture of the 4th spinal nerve which in the hands of a physiologist may well have interesting significance, especially, in view of the fact that the axons of these atypical neurons are distributed almost entirely to the celiac plexus and hence constitute a large component of the sympathetic nervous system which supplies the viscera.

Thus far a study of action currents made by Dr. George H. Bishop of these various nerve branches substantiates the neurological findings, and subsequently other physiological attributes and functions of these nerves will be investigated.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 7.)

DEPARTMENT OF BOOKS

EXPERIMENTAL PHYSIOLOGY FOR THE CLASSROOM AND THE LABORATORY

EXPERIMENTAL PHYSIOLOGY, Visscher, Maurice B. and Smith, Paul W., 191 pages, 75 figs. 1935. $3.25. Lea & Febiger, Philadelphia.

This little volume of 191 pages and 75 figures contains over one hundred experiments appropriate to a class in medical physiology. Following a brief introduction and directions to students, are chapters on the general properties of protoplasm, muscular activity, the circulatory system, respiration, the nervous system, sensations (mainly the eye), digestion and absorption, metabolism and internal secretion, and urine secretion. The experiments selected cover a wide range of laboratory procedure and theoretical material and are described with sufficient clarity and completeness so that students should be able to follow them without additional laboratory dissertations by the instructors.

Fortunately the authors have added to the majority of descriptions a reference or two, which may encourage the users to do more than slavishly follow a prescribed laboratory program. An appendix contains useful information on the preparation of common reagents and performance of many routine procedures as well as such physical data as are often required and, especially, a condensed table of drug dosage for and action in common laboratory animals. The volume should prove a useful one in teaching physiology and handy to have about the laboratory.

R. W. GERARD

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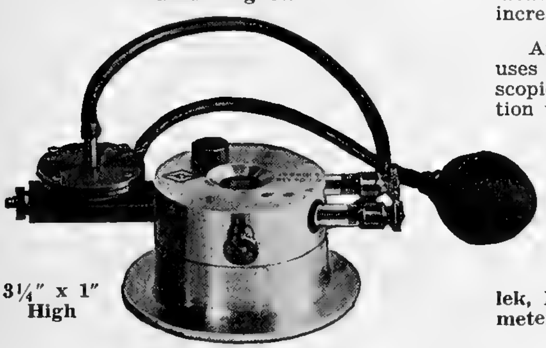

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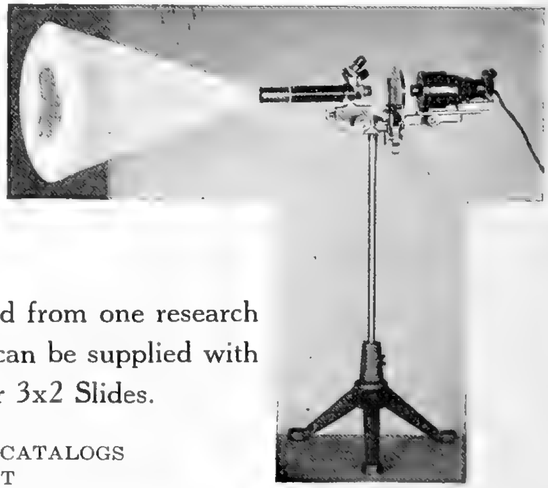

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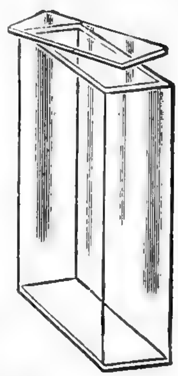

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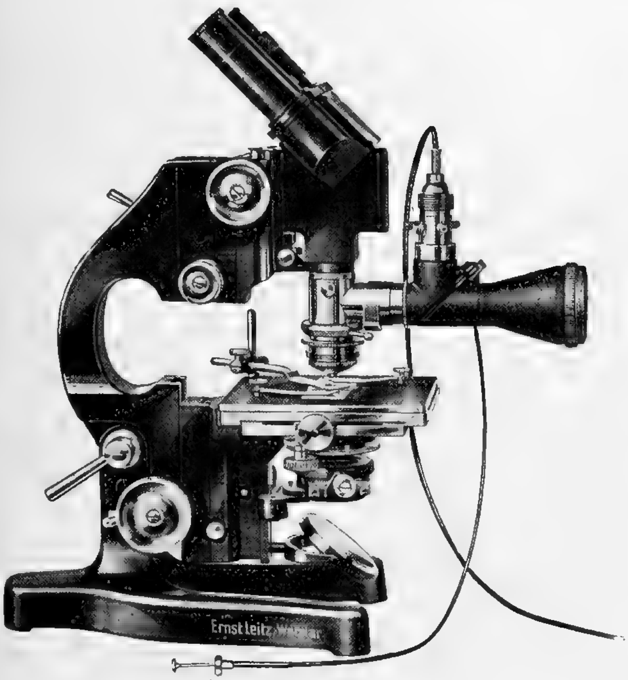

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THE WOODS HOLE LOG

THE TRAFFIC SITUATION IN WOODS HOLE

Very few towns are afflicted with a condition which retards the free passage of motor vehicles to such an extent as is the case in Woods Hole on its main street. Time and time again cars proceeding up or down Main and Water Streets are stopped, because two cars can barely pass each other in the middle of the road when cars are parked on either side. A single car parked on the south side of the road is often responsible for stopping traffic in one direction. The present situation is a source of annoyance to all persons with cars; it is a source of danger because it may sometime block the fire engine in an emergency. The situation is in the hands of the Police Department; parking should be strictly limited on the south side of Main and Water street. —*C. N.*

Mrs. Geoffry G. Whitney opened her home on Little Harbor, Woods Hole, last Wednesday, July 8, for a sale of goods made by disabled veterans. The Boston headquarters of the Disabled Ex-Servicemen's Exchange was in charge. A wide variety of handicrafts among them woodcarving, jewelry, pewter, knitting, and embroidery were sold.

Alexander Kirkland, Group Theatre leading man, will star in George Bernard Shaw's hilarious play, "Arms in the Man," which opens Wednesday, July 15, at the Beach Theatre, West Falmouth. The play will run through Saturday with a Thursday matinee.

Other members of the cast are: Beatrice de Neergaard, Hortense Alden, Horace Sinclair, Scott Kolk, Edmonia Nolley, Stanley Harrison, and Robert Bentley, all recruited from Broadway. This is the second presentation of the season, the first being "Personal Appearance" with Dorothy Mackaill.

Dr. and Mrs. Frank R. Lillie have had as guests their daughter and son-in-law, Mr. and Mrs. William Walton of New York. The couple left Wednesday but they plan to return to Woods Hole in August.

Gifford Griffin, a Laurence High School and M. I. T. student, is employed at the General Electric Plant at Lynn, Massachusetts.

Robert L. McKenzie, Woods Hole's gifted musician, has returned to New Hampshire for the summer months. He is employed in a hotel at Crawford Notch. Mr. McKenzie is a student at the New England Conservatory of Music.

THE ETERNAL BEACH QUESTION

TO THE EDITOR:

Coming from New York City with a great desire for relaxation, bathing and basking in the sun, I dreamed of pleasant beaches on which to idle away the summer hours, hoped to regain vigour for my strained and overtaxed nerves, and to build up a reserve of courage and strength. The Cape Cod Advancement Plan and the Chamber of Commerce have spent a small fortune in advertising Cape Cod with all its sunshine and good bathing, and knowing the Cape extremely well since early boyhood, I agree that in many places there are fine sandy beaches. But I happen to like particularly the quality of many things about Woods Hole. I like the cool air and the pleasant and busy harbor, besides which I have many friends, so that altogether Woods Hole affords me most of what I desire, and my only objection concerns the painful state of the beach. I say painful advisedly because I must again remind you that coming from New York City, I have tender feet, and during my brief stay here I have seen many adults and children with tender feet. No wonder that a friend of mine and his three children recently picked up and departed for other shores where the children could play contentedly for many hours. I am amazed that the Park Commission and Selectmen of Falmouth have no sympathy with the many who have to live and study in Woods Hole, and cannot afford either an automobile or the time to go to the other beaches which are so ably and admirably kept up. It is no excuse that the beach is privately owned because the Woods Hole Public uses it by the hundreds, and they cannot be forbidden. It might seem that private ownership is defeating itself and that perhaps the Council of Falmouth should take charge and enforce the public pleasure and rights. Lastly, I am amazed that each store keeper and boarding house owner does not protest to the Falmouth Selectmen. I am only one of the many hundreds who leave a large part of our yearly savings in these parts, and I believe we deserve some consideration.

ANONYMOUS

On July 3 the Penzance Players met and elected officers for the coming season. They are: Albert Borden Jr., President; George Compton, Secretary-treasurer, Peggy Clarke, Technical-director, and Nathan Calkins, member at large. The members also decided to give a play sometime in August, but the play has not been selected.

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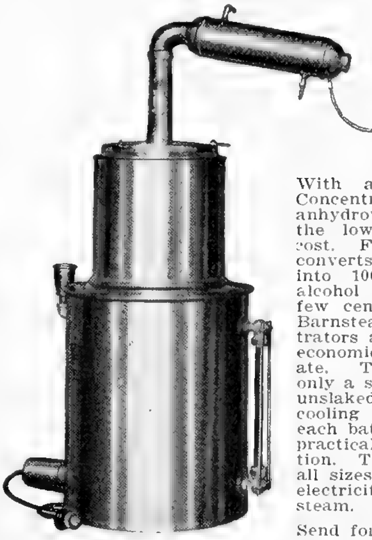

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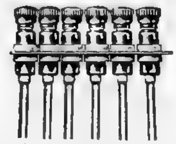

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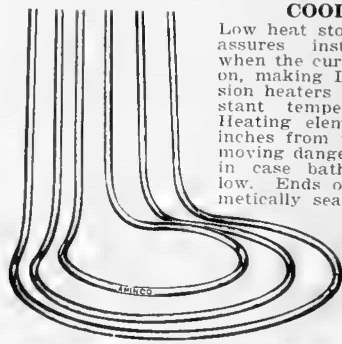

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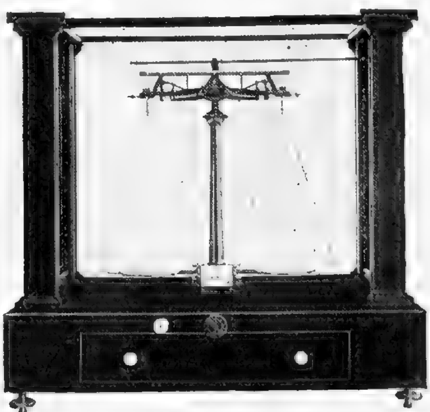

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THE COLLECTING NET

Vol. XI, No. 3 SATURDAY, JULY 18, 1936 Annual Subscription, $2.00 Single Copies, 30 Cents.

SOME FACTORS CONTROLLING THE ELECTRICAL ACTIVITY OF THE BRAIN

Dr. Ralph W. Gerard
Associate Professor of Physiology, University of Chicago

Evidence from isolated neurones, inverterbrate ganglia and the frog cerebrum, confirms the indications of *in situ* observations that individual neurons are able to show a rhythmical electrical beat in the absence of impinging nerve impulses. The recorded rhythms depend in part on the frequency of the individual neuron, in part on the degree to which the many neurons affecting the electrode are synchronized. An analysis of some factors controlling these phenomena has been undertaken.

Synchronization is greatly increased by polarizing the brain (cat under nembutal) with a weak constant current. In sleep also large slow waves suggest improved synchronization. The play of afferent impulses ordinarily disrupts preexisting rhythms but may enhance them on the one hand or even abolish all potentials on the other. These phenomena can all be seen in portions of the optic pathways of the cat's brain. In last (*Continued on page 72*)

M. B. L. Calendar

TUESDAY, July 21, 8:00 P. M.

Seminar: Dr. W. W. Ballard: Observations on lens regeneration in Amblystoma.

Dr. T. H. Bissonnette: Fertile eggs from pheasants in January by night-lighting.

Dr. Roberts Rugh: A quantitative analysis of the anterior pituitary-ovulation relation in the frog.

At the close of the meeting a moving picture entitled Experimentally Induced Coupling in the Toad, **Xenopus Laevis**, by Dr. H. Shapiro of the University of London will be exhibited.

FRIDAY, July 24, 8:00 P. M.

Lecture: Dr. C. E. Renn: The eel grass situation.

THE CHEMICAL ROOM, ITS PAST AND ITS PRESENT. II.

Dr. Oscar W. Richards
Instructor in Biology, Yale University

Nine years have elapsed since Dr. Oliver S. Strong described the origin and early development of the chemical room in the first article of this title.* During this time Dr. Strong has become Chemist Emeritus by the gradual process of turning the work over to the writer. The present well developed and arranged Chemical Room is a tribute to Dr. Strong's skill, patience and industry. His friendly counsel and continued interest in the Chemical Room are among the valuable assets of the Marine Biological Laboratory.

The Chemical Room measures the population of the laboratory by the number of order books issued. This number is less than the total number of investigators because each class is represented by a single book and one book may be used jointly by several investigators from the same university or working on the same program. Nevertheless it is a useful unit. Students from the same university and working in the same room

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now share one book. In so far as possible beginning investigators use the book of the worker responsible for their work. Several books may be issued to graduate students from the same university when they are assigned to rooms in different buildings to avoid geographical confusion. This reduction in the number of order books both follows the ruling that the beginning investigators are to obtain their supplies through the person responsible for their work and lessens the labor involved at the times when the cost is computed for each book.

The main problems of the chemical room are concerned with the rapid arrival of investigators who desire to start work as soon as possible, and the fact that the stocks are idle about two-thirds of the year. Between the middle of June and about July 10th sixty-five percent of the books for the entire season are issued. During these three weeks, about eight books are issued each day (Fig. 1) and this number of groups of investigators must be equipped. After this time the investigators come slowly and the work of the chemical room reduces to supplying the daily working needs. In addition, during the same period of time, four of the five classes must be equipped; this would not be possible with the present limited staff if it were not for the cooperation of the class instructors in giving us their supply lists sufficiently early to prepare and assemble the orders before June 15th.

When the depression began seriously to affect the biologists about 1932, fewer of the investigators stayed late in the season, but the last two years suggested a trend toward a longer season and an active force must be kept in the Chemical Room later than during previous years. In order to evaluate the change, the departure statistics by books are being kept and the data so far available are shown in Figure 1. The rapid emigration of investigators at the end of the season floods the chemical room with the materials coming back but as they will not be needed until the next year much of the winter may be used to restore order.

During the first of the depression years prices declined more rapidly than the chemical room budget and it was possible to increase stocks of staple articles such as coplin jars, aquaria, finger bowls, etc. A stock of heavy glass aquaria was obtained just before the devaluation of the dollar. Imported glassware prices are now so prohibitively high that the Laboratory is not stocking them. The cost of laboratory supplies has been increasing for about two years. A year ago the NRA put more or less uniform prices into effect, but last winter's bids on the large order showed a highly competitive market with little agreement outside of price-fixed items like Pyrex and Kimball glassware. Five different prices were bid on the same reagent grade chemical of one manufacturer. This makes efficient buying very difficult, requires some experience, and makes imperative a knowledge of the sources and factors back of the laboratory supply house prices. The only discounts now available are for cash and for quantity orders.

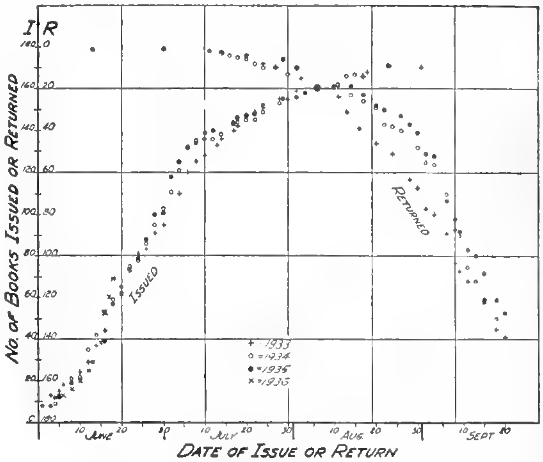

FIGURE I.

In 1932 and 1933 many investigators expected the chemical room to furnish some of the less usual and more expensive items that they would have brought with them before their own budgets were reduced. In some cases it was not possible for the chemcial room to furnish these materials, and in other cases the cost of the special material was shared by the investigator. The coöperation of the investigators, both then and now, is greatly appreciated and has made possible carrying on under these trying circumstances. As compared with Dr. Strong's last figure, the present chemical room budget is reduced about twenty-six percent. The budget at present barely covers the replace-

* **The Collecting Net, 1929.**

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

TABLE 1.

Standardized and Special Solutions (Liters)

Year Chemist	1929 Hale	1930 Wilson	1931 Hale	1932 Laug	1933 Laug	1934 Laug	1935 Laug
N NaOH	15	8.6	10	1.4	7	2.6	3.1
0.1 N NaOH	7	4.9	3	4.8	2	5.8	3.7
N HCl	10	10	9	1.8	1	0.9	3.5
0.1 N HCl	5	4	4	4.7	2	5.4	2.1
N H_2SO_4	8	0.7	1	1	0.8	0.7	1.9
0.1 N $Na_2S_2O_3$	....	....	....	....	4	2.6	5.0
N HAc	3	2.5	2	0.5	0.3	0.3	1.5
Misc. std. sols.	....	....	....	....	....	39.6	35.8
Totals standardized solutions	48	30.7	29	14.2	17.1	58.9	56.6
Special solutions	....	....	....	45	141	26.1	28.0
Saline solutions	....	....	....			91.7	64.3
Buffer solutions	12	10	13	14	31	18	24
Color tube sets (pH)	32	30	42	32	22	40	23
Investigators using							
CO_2*	....	5	5	3	5	4	7
H_2	....	5	4	4	5	3	4
N_2	....	7	6	6	6	7	7
O_2	....	9	13	10	9	13	14
Photographic developers	....	....	....	....	38	36	70
Photographic fixing fluid	....	....	....	....	43	87	75
Distilled water (gallons)	....	....	2316	2215	2491	3422	2816

* Does not include truck size cylinders or lecture bottles.

ment supplies for the season and offers little for use in building up stocks. The dream of enough finger bowls, etc. to satisfy the needs of all the investigators seems to be fading.

A considerable amount of information has been obtained as to sources of unusual items required in biological work. This information will be shared with biologists if they will ask or write to the person in charge of the Chemical Room.

The most useful single recent addition to the chemical room is the visible index inventory system which gives the location in the chemical room of every item, shows any restrictions as to its issuance (e.g., when signatures are required in the narcotic book), the minimum stock inventory taken in late August each year, and the amount ordered on each winter order. The cards carry this information for six years and have been a great help in planning orders. This is not the first inventory but the modern visible methods, not available hitherto, have replaced the enormous books which Dr. Strong so ably described in his previous article on the history of the chemical room. The index has been especially useful to the winter force and to members of the staff during their first year. There are now about 2,750 different items listed, of which 250 are dyes, 1500 are chemicals, and the rest general equipment.

The changing pattern of biological research work and the growth of the Marine Biological Laboratory have forced the shifting of items from the chemical room to the apparatus room, and vice versa from time to time. Changes have not been made without careful consideration and the occasional inconvenience caused the investigator by a change is regretted. It is hoped the new location of the apparatus room in the basement of the Brick Building (Room 3) this summer, will make it possible to locate all equipment and to prevent any investigator losing time or energy in determining what is real apparatus and what is to be found with the chemicals and the glassware.

A solution balance of 20 liter capacity has been added which makes possible the preparation of large quantities of special solutions with accuracy and with economy of time and material. The staff member responsible for the standard solutions now has a small room within the chemical room dehumidified by a stack heater for his balance. It is possible to weigh accurately in this room during foggy weather when the rest of the chemical room may have a relative humidity of over 90%.

Common tools have been made available for 24-hour loans to investigators at times when they wish to do minor repair work or during packing and unpacking. The apparatus room furnishes kits of tools at a moderate rental when the use is required for the entire summer. The chief difficulty is in keeping screw drivers, and the staff has sometimes wished that those people who cannot seem to remember to return screw drivers might bring their own.

The chemical room has sponsored and persuaded the Empire Biological Supply House to make a 10-inch finger bowl which has all the advantages of the finger bowl and is large enough to replace the familiar crystalizing dish. These finger bowls break less easily, both when on the shelves and in use in the laboratory and the field.

The demand for standard chemical solutions has continued, and during the past six years the staff member responsible for this work has had chemical training equivalent to a Master's degree or better. For this work certified graduated glassware is available and the solutions are as accurate or better than stated on the label when they are issued. The main changes in this branch of the service have been toward quantity production with no sacrifice of precision. The fact that these are used for such a short season only precludes the cost of some more permanent standards.

The amount of the special chemical work and changes in its volume are shown in Table 1. The demand for hydrogen ion color tubes reached a high of fifty-six sets in 1927 when it was the current biological fad. The next year the number prepared and issued dropped to thirty-two, showing that the hydrogen ion concentrations did not solve many problems, and since then the demand has been steady, except that the last year again showed a marked drop. The year 1934 will always be remembered as the year of artificial sea water and profusion fluids.

This year a joint service will be made possible by the Chemical Room and the Apparatus Room with a chemist in charge of adequate equipment for measuring the hydrogen ion concentrations of biological fluids. He will maintain apparatus in proper condition and will measure the pH values for investigators, thereby saving the investigator the trouble of keeping delicate apparatus in order and giving a greater accuracy than may be obtained by the color tube method. Should this addition to the service be useful and well received, it is hoped that it may be possible to extend it into related fields in the future.

The publication of "The Formulae and Methods"* by the chemical room staff has aided a great deal in standardizing biological reagents and has permitted us to place our policy on record. Special solutions will be prepared when the formulae are provided, insofar as the demands on the service permit. The published formulae do make possible keeping certain of the more popular and stable solutions on the shelves.

Some mistakes have been made and the writer is greatly indebted to those investigators who have come to tell him about them, thereby making it possible to avoid making the same errors in the future.

Many investigators write down in their order book exactly what they need and their order can be filled in a short space of time and with a minimum amount of effort. About fourteen round trips to the far end of the chemical room provides a mile of walking on a concrete floor. Consequently when investigators change their minds and require a staff member to cover this distance three or four times, it becomes a severe physical tax. It is only apparent to the biologists who have worked in the chemical room how little standardization of materials there is in biological work. Few people use the same materials and concentrations, so there is no usual kind except for a very few items.

Another problem is, how pure should the chemicals be? For instance, the Fuelgen reagents require normal hydrochloric acid. However, that needs to be only approximately normal, say to the first decimal place, rather than being accurate to three decimal places. When the correct accuracy is specified, much material and considerable time may be saved by using the less accurate material when that is appropriate and a more accurate material when it is required. In recent years there have been less demands for unopened bottles and every effort will be made to maintain the purity of the chemical stocks so as to continue to justify this faith of the investigators. The labelling of distilled water carboys has been an aid in preventing their use for other material and we especially appreciate investigators cooperating in this matter, because a small contamination in the distilled water might have far-reaching effects on the work of the laboratory. Sometimes even careful investigators contaminate the distilled water carboys. I recall one case where we found chloride in the

* **Collecting Net,** I 1930, 5 (Suppl.) 12 pp.; II. **Ibid** 1932, 7 (Suppl.) 8 pp.

carboy and upon investigating found that another carboy had just been placed on the floor where the salt water spattered into it.

Dr. Strong once told the writer a story about one of the chemists during the early history of the Chemical Room which may now be repeated. It seems that this chemist used always to ask the investigators to bring their own container when they ordered a special solution. When the investigator brought a carefully cleaned and dried bottle the chemist gave him some of his very best solution, but if the individual just brought in a wet graduate he dumped in almost anything at hand, because, as he said, that biologist couldn't tell the difference anyway. Such a procedure could not be tolerated at the present time, but it does illustrate how much might be saved if investigators would always specify the purity of the reagents required for their work.

Another difficult problem is that of how much material is required. Sometimes a very large number of Syracuse watch glasses are needed for a few days for a special experiment. The requests for large numbers of an item can ordinarily be cared for by listing the material in the loan book. Then, should some investigator arrive late in the season and require them, it is possible to ask those who have large numbers to return as many as they can spare. The investigators have usually approved of this policy. How much should be kept in reserve stock for those investigators who come during the middle of the season becomes a problem. Material should not be idle on the shelves and yet the person who comes later must have equipment. Only by close coöperation can efficient use be made of the laboratory equipment.

The modern beginning investigators seem to be more sophisticated than they were a student generation ago. It has been a long time since someone has asked for a thousand dollars worth of osmic acid in one solution, though we still get a few unusual requests. Most of these are now concerned with the problems of solubility. One investigator was quite perturbed when we could not make a molar solution of calcium sulphate. Another investigator desired a considerable amount of buffer of pH 15, which is not a practical solution for us to prepare. A few fads come and go but for the most part they do not arise from any large body of the investigators. Most of the people now seem to have definite problems which they are carrying on over a period of years, and it would seem that much biological progress should follow this trend.

Glassware stored for some nine months is bound to accumulate a certain amount of dirt on its surface. When this glassware has not been returned clean, then the problem of washing it in the summer is serious. We have noted an increasing tendency among the investigators to clean their glassware before returning it to the chemical room stocks, which has made possible the issuance of much cleaner glassware the following summer. At the present time the single winter man cannot clean the glassware which has been returned dirty. Perhaps some day the staff will be large enough to take care of this matter so that clean glassware may always be issued. In the meantime returning the glassware clean will benefit all investigators.

A few years ago the chemical room was forced to make up as much as three 180 pound carboys of sulphuric acid into cleaning fluid. The result of the use of so much chemical cleaning fluid was that the sinks and plumbing of the laboratory were getting possibly more cleaning than the glassware. There is also danger in the use of chromium which will be mentioned later in terms of research. Investigators have been asked not to use any more than the minimum amount and as a result it is believed that much of the laboratory equipment will be saved and possibly the errors from chromium poisoning may be eliminated.

During the last three years all fillable orders which have reached the chemical room by three-thirty o'clock in the afternoon have gone out the same day or else the very first thing the next morning. Frequently people come at four o'clock and are very anxious to have a special solution made up so that they may have it about closing time. It has been observed that when these solutions were put out on the window sill at closing time they would be found there at opening time the next morning. In emergencies assistance will be given in any way possible and investigators are invited to ask help from the person in charge at such times.

During a part of one year the Chemical Room was kept open for two hours in the evening and for a short time on Sunday. The result was that a few orders came, but the number of orders was so small that it did not justify the expense. It is felt that the present arrangement will take care of any unusual requirements without keeping the chemical room open beyond the regular hours. This may be changed when our budget is increased.

Another type of service that was tried was to put strings on the order books and send them to the rooms with the supplies. A member of the chemical room staff called at each room during the morning of each day and took any orders to the chemical room. This did not prove very satisfactory either, because no one time of collection was convenient to all of the different investigators, and we found that so few investigators used this room service that the extra work was not justified.

In making appointments to the chemical room staff preference is given to those people who can profit from the advantages to be obtained at Woods Hole and who usually could not come to Woods Hole without the small help from the stipend offered by the positions. This policy has led to the present members of the staff being somewhat older, more experienced, and better trained that they were in previous years. Few junior members are appointed now because it has been felt that during the depression the funds should go to those biologists who really needed the help. Staff members who are earning their own way may be more efficient.

The members of the staff since the previous report and the seasons that they have been here are: Edgar M. Adams, 1933; Muriel Ashley, 1929; Mrs. A. P. Ayling, 1929; Eric Ball, 1936; J. H. Bentley Jr., 1928; A. L. Chute, 1933-34; John Deitrick, 1929-31; Mary Derrickson, 1935--; Anna Dunlap, 1929; Pauline Frew, 1930--; Dorothy Geib, 1930-31; Dorothea Haas, 1928, 1930; J. B. Hale, 1928, 1929, 1931; Katherine Hawley, 1935; Sally Johlin, 1930-33; Elsa M. Keil, 1928--; James B. Lackey, 1931-32; E. P. Laug, 1932-35; Marie Laug, 1934; Anne Litzinger, 1929; Helen Lundstrom, 1930; W. G. Marquette, 1936; Louise Mast, 1928, 1932-34; Evelyn Mekeel, 1928; Ethyl Parpart, 1929-30; R. M. Patterson, 1928; Oscar W. Richards, 1927--; Betty Spivack, 1928; Chester Stock, 1936; Sibyl Street, 1930-32; Betty Titlebaum, 1929; Mary C. Tupper, 1932-33; F. E. Wilson, 1930; W. A. Wolff, 1929; and Anne Wollock, 1935.

Staff members have been encouraged to do research work either on problems of their own or on problems of interest to the Chemical Room. Of the latter type of problem the purity of chemicals, especially the chlorides, has received study. Some makes of basic fuchsin have been found not to decolorize and are therefore unsuitable for making Feulgen stains. Once that silver was known to be an impurity of sodium chloride, the chemical room arranged with Merck and Company to manufacture a sodium chloride suitable for biological work. Dr. Laug has worked out a method for quantitating very small amounts of chromium such as are left to adsorb to glassware after cleaning with sulphuric acid by chromate killing fluid. Knowing the amounts that may remain it has been possible for the writer to demonstrate how important these amounts may be in biological experiment.

Considerable attention has been given to the problems of making large amounts of solution, e.g. buffer solutions, with a high accuracy. Another problem that is being studied actively at the present time is how best to prevent mold growing during the parts of the summer when the relative humidity is high (80-95% within the Chemical Room some seasons). Several members of the chemical room staff have worked on this project and it is believed that the present summer will give conclusions definite enough for a constructive program for the future. A serious problem concerning the chemical room is that of corrosion. The damp, salt air causes most materials to rust, and a great deal of the equipment depreciates through corrosion to an alarming extent. Means of withstanding this corrosion are being studied. Some materials like monel metal withstand corrosion but are toxic to living organisms, so that the problem is more complex than if it were a mere matter of avoiding corrosion alone.

The regeneration of *Polychoerus* and of *Pennaria* has been studied by Elsa Keil. The writer has measured the rate of conduction of the nervous impulse in *Mytilus* and the effect of neurophil drugs on *Uca*. The growth of *Mytilus* has been measured for six consecutive years. The toxicity of some metals and of Berkefeld filtered sea water has been studied with the same mussel. Small amounts of chromium which may remain after usual washing of sulfuric acid-bichromate cleaned glassware have been shown to poison living organisms. Miss Florence Haynes and the writer have measured the oxygen consumption and carbon dioxide production of yeast and a critical study of the yeast detector method for demonstrating a possible mitogenetic radiation was made with Dr. G. W. Taylor. The action of thionyl chloride upon certain amids, urea, and urethanes was investigated by F. E. Wilson.

In addition to the published studies, Dr. J. B. Lackey has prepared material on *Haminea* and Miss Katherine Hawley has studied means of killing molds both of which will ultimately be published. Both Drs. E. N. Adams and J. B. Hale have prepared compounds used in their research work for the doctorate. The work of Dr. W. A. Wolff was largely concerned with the chemical methods necessary for the accurate preparation of large quantities of special solutions. Miss Louise Mast studied certain protozoa, R. M. Patterson worked on the nervous system of crabs, Sibyl Street tested the effect of thyroxin on embryonic development, and Mary Tupper started a program of measuring the freezing points of killing fluids and saline media.

Research work by members of the Chemical Room Staff usually has to be done outside of Chemical Room hours and the above summary illustrates that they are taking advantage of the opportunities offered at the Marine Biological Laboratory.

Very few changes have been made in the general procedures used in handling orders and materials in the Chemical Room. Since these have

been adequately described in Dr. Strong's earlier report they will not be repeated here. This report has been prepared to show what the present problems of the Chemical Room are, and how they are being met. By stating these it is felt that the investigators will be able to aid us in improving the Chemical Room service. Criticism should be given to the person in charge, and each investigator may be assured that any suggestions made will be carefully considered.

In closing it seems fitting to quote again the last paragraph of Dr. Strong's report, because the spirit of it aptly expresses the program of the Chemical Room.

"When it is remembered that the Chemical Room supplies and distributes material not only for several classes of quite different character from each other but also for well over two hundred investigators* working in very many varied lines of research, it is evident that the problems presented are quite unique. There is more analogy to the problems presented by the supplies for a whole university rather than for any single university department. As far as the writer is aware these problems have, in the main, been successfully met. It might also be delicately intimated, when it is remembered that some investigators, especially perhaps those in their earlier careers, do not welcome suggestions, that diplomacy and tact is a very desirable quality in the members of the Chemical Room staff. The M. B. L. obviously cannot provide a series of laboratories each equipped on a scale equal to that seen in each university represented at the laboratory and it is earnestly hoped that any suggestions made by members of the Chemical Room staff will not be received as though reflecting upon the ability or experience of the investigator."

*[Now over three hundred.]

SOME FACTORS CONTROLLING THE ELECTRICAL ACTIVITY OF THE BRAIN

(Continued from page 65)

analysis, however, the beat of the individual cell must depend on its metabolic activity and so on the physico-chemical state of its immediate environment. Changes in the chemical state of the blood have been shown to modify activity, especially in the lateral geniculate body (where most observations were made). Increased blood potassium exaggerates a fast rhythm, calcium eliminates all potential variations except a very smooth, slow change. Applied locally to the cortex in isotonic concentration, potassium abolishes responses to light. This effect is reversed by calcium though by itself this also is able to block. Preliminary experiments indicate that hypo-glycaemia induced by insulin acts as potassium, hyperglycaemia like calcium. Increased carbon dioxide decomposes the slow rhythm in man and increases the rapid waves, while decreased carbon dioxide tends to increase the magnitude and slow the usual ten a second rhythm to about three a second. Cyanide and methylene blue are able to change the brain potentials markedly.

It is important that the intrinsic factors—chemical, neural, and electrical—which control the beat and synchronization of neurons be further elucidated before the new electrical techniques are applied extensively in the field of human pathology.

(This article is based on a seminar report given at the Marine Biological Laboratory on July 7).

PHYSIOLOGY CLASS NOTES

The past week in the Physiology course has been one full of interest, curricular and otherwise. On Wednesday Mrs. Harvey gave a demonstration of her centrifuge microscope, showing the definite layering which occurs in arbacia eggs when centrifuged at the rate of 10,000 times per minute. On Friday Dr. Prosser made a large electric torpedo ray perform some tricks such as lighting a lamp, ringing bells and giving electric shocks to those who got in the circuit. It was suggested by a student wit that one might be used for a combination door mat and door bell.

Those people working with Dr. Höber felt they had earned a night's repose when they had successfully cannulated the aorta, abdominal vein and ureters of a frog. When this phenomenon occurs, Dr. Höber beams and is glad; and when it doesn't, which is often the case, he is sympathetic. But in either case in the midst of turmoil and clumsiness he may be heard humming the Soldier's Chorus or Tannhauser. This is the third summer Dr. Höber has taught here, so he is familiar to most of Woods Hole. During the winter he and Mrs. Höber work at the University of Pennsylvania to which they came two years ago from the University of Kiel.

We were fifty strong when we started off on our outdoor group experiment. The weather was not propitious but there was no alternative. We had to go on and surely this experiment would work with the excellent cooperation of practically all the faculty working right along with us, to say

nothing of the resources of the other experts who were accompanying us from related fields.

A sharp "beep-beep," all hands signed on, and the food supply checked by a wary eye. The *Winifred* slid from the dock and sailed majestically out of the Eel Pond under the bridge; suddenly we found the sun was with us after all. A short two hours of steady put-put from the boat and much singing under the direction of Mr. Dugal and with the assistance of Drs. Höber and Gerard brought us within reach of our goal. Through the kind aid of some willing rowers and the dories, and a few large plunges into the cold water by our more dashing members, namely, Messrs. Smith, Reed Fisher, Ratnoff, and Dr. Irving, all were safe on the very white sands of Tarpaulin Cove. It had convenient shade trees and lacked biting insects. A neighborly farm offered a means for the long talked of ball game to which the male quota retired while the more gentle sex played ball in the water. Finally, hunger overcame the best and worst of us and lunch was served under the trees. We were particularly delighted to find that the lobsters, clams, sweet potatoes, and chicken were still warm and really hot to handle. Sandwiches, fruit, and cakes supplied by the Mess and soft drinks completed the feast and with a small excess of everything in full view, congratulations were extended to the committee.

Very shortly after lunch, the diversions of the group varied, really to the extreme. Some slept, others had serious discussions, and one energetic group, under Dr. Amberson, started off on the five mile walk to the Point, where they hoped to be picked up by the boat later. Some of the true investigators went out in the boats and found that bell buoys have to be turned off once having been started to ring. They were unable to elicit even a polite word from the wife of the lighthouse keeper who had to trudge down to stop the bell. The group further divided around four o'clock and the boat party or softies, as our former associates called us, pulled out leaving the hardies to follow the footsteps of the previous walking party to the Point.

On reaching the Point, the boat left off the provisions for supper for the second walking party and took on the members of the first walking group. So we returned to Woods Hole only about twenty-five strong but quite at peace with the world in general.

But our day was as yet unfinished as once again the weather rapidly became unpropitious and this time seriously so. A rescue party was sent out in the midst of much wind, lightning and thunder to pick up the residue (to use Dr. Irving's own term which happened to include him this time). This was a few hours earlier than per schedule; so by nine o'clock we were all safely accounted for with no casualties beyond colorful sunburns, sore leg muscles, and, for a few, very wet clothes.

Elizabeth Mayers and Alburta Wood.

EMBRYOLOGY CLASS NOTES

This week the chronicle of events should be written boldly in thick, black squid ink, applied with a squid "quill." Several circumstances mark it important as the class begins to look into the last part of its stay here.

Highlight number one was the study of the complexly phototropic *Bugula flagellata* larva under the direction of Dr. Grave. The students were given the opportunity to watch the larvae attach and multiply by budding into branching colonies with snatching, "bird-head" avicularia.

Highlight number two: the development of *Loligo pealei,* which was also studied under Dr. Grave. The material had appeal for all types of students. The vari-colored, pulsating chromatophores of a stimulated animal created universal interest. Some students found the adults had an efficient water-throwing weapon. The parasitologists discovered a primitive tapeworm in the viscera. The physicists admired the mechanism for release of sperm from the spermatophores. The souvenir hunters (and those who wrote up the 7 to 6 baseball victory of the class over the physiologists on Monday night) were united in agreeing upon the value of the pen-bearing squid.

If the study of Nereis is thought not to be a highlight in the course, the moonlight gathering of the class at the Eel Pond may be so considered. The gathering witnessed the lunar-governed breeding habits of this marine annelid on Wednesday night. In the morning Dr. Packard had spoken on details of maturation and fertilization as they may be observed in Nereis. On Thursday Dr. Packard lectured on cell lineage, using prepared slides of Crepidulus and developing eggs of the grotesque Chaetopterus as laboratory material.

In the evening, the students were dragged from their work by physiologists from the neighboring laboratory classroom. The softball champions had been challenged; but they easily carried the day by defeating the embryo-micrurgists 12 to 6.

Highlight number four was the lecture delivered by Dr. Chambers. He explained, on Friday, certain features of development as examined and clarified by him in his work with micro-manipulation.

Highlight number five was the official class excursion to Tarpaulin Cove which started Saturday under cloudy skies aboard the *Winifred.* Happily, the weather cleared so that by lobster-eating-time, the sun was glowing brightly. The

(Continued on page 76)

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

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THE MARINE BIOLOGICAL LABORATORY AND THE COLLECTING NET SCHOLARSHIP FUND ASSOCIATION

In the last number of THE COLLECTING NET we had the privilege of printing letters concerning THE COLLECTING NET Scholarship Fund Association from four of the largest marine laboratories in the United States; they were the Marine Biological Laboratory, the Scripps Institution of Oceanography, the Biological Laboratory at Cold Spring Harbor and the Mt. Desert Island Biological Laboratory. The first mentioned replied in the negative to our suggestion that it appoint an official representative as a trustee of the Scholarship Fund; in the case of the three other laboratories the directors of each consented to serve on the board.

We are likely to be carried away on a wave of enthusiasm and perhaps be too certain that THE COLLECTING NET Scholarship Fund Association will be successful and, that in the end, with advice from older men who know more than we do, it can be a very definite factor in contributing to the advancement of research work in the biological sciences in America.

The Marine Biological Laboratory has given no definite reason why it should not appoint a representative as trustee and we think that the question is one of considerable interest and importance. We therefore invite discussion in our columns concerning this point. Obviously there are two sides to the question; we are convinced that they should, the administrative officers of the laboratory feel equally strongly that there is no occasion for them to be officially represented in the association.

Complimentary Research Space for Scholars

The following letter is being addressed today by special delivery to the directors of several marine biological laboratories:

The plans for THE COLLECTING NET Scholarship Fund are advancing rapidly; the following individuals have accepted appointments as trustees of the fund:

Dr. T. Wayland Vaughan
Dr. Eric Ponder
Dr. William H. Cole
Professor Edwin G. Conklin
Professor C. E. McClung
Dr. Charles S. Dolley

At once another question is raised and I should be glad to know the attitude of your laboratory concerning it. In the case of many fellowship and some scholarship awards for scientific work the institution at which the "awardee" is to conduct the work provides complimentary facilities for the investigator. It would of course be a great contribution to the fund if each laboratory could see its way clear to grant free research space to individuals holding a scholarship, so that the entire one hundred dollars in each case could be applied towards traveling expenses, board and room.

The recipients are highly selected. First the students or young investigators working in a given laboratory are carefully selected by the individual institution; the scholarship is then awarded under the immediate advice of those most competent to know who the best individual is to receive the award which has been assigned to a given group. Probably in your laboratory there are now individuals who are granted free research space for one reason or another; it is hoped that you can consider the possibility of extending this arrangement to recipients of COLLECTING NET Scholarships.

I shall appreciate it if you can write soon concerning this matter so that an announcement—in case you react positively to our suggestion—can be made indicating that at certain laboratories recipients of THE COLLECTING NET Scholarships can obtain complimentary facilities to carry out their research work for the period of a single summer.

It is hoped that at least some of the answers to the letter can be printed in the next issue of THE COLLECTING NET.

Introducing

DR. VINCENT MORAGUES, Medico de guardia Clinic Hospital, University of Barcelona, Spain. Dr. Moragues was born in Andraita, Majorca, Spain, in 1911. He attended school both in Cuba and Majorca; in 1934 he received his degree of doctor of medicine from the University of Barcelona. While studying for his degree he worked under Professors Pi Suner, physiologist, and Ferrer Solervicens, medical pathologist.

Dr. Moragues assisted at the hospital of the medical school in Barcelona in his university days. For the past years he has been guard or resident physician at the hospital. Since his arrival in America on May 4 Dr. Moragues has assisted Dr. Michaelis at the Rockefeller Institute for Medical Research in New York before his arrival at Woods Hole. He is now a member of the Physiology course. In the fall Dr. Moragues will return to New York to continue his work with Dr. Michaelis on physical chemistry applied to medicine. *E. T.*

ITEMS OF INTEREST

Dr. Charles S. Dolley, founder of the Department of Zoology, at University of Pennsylvania, has been visiting Woods Hole this week. During their brief sojourn he and Mrs. Dolley were the guests of Mr. and Mrs. Seward Prosser of Penzance Point. On Thursday morning Dr. Dolley left by car for Providence; soon after he planned to return to Philadelphia where he is completing a biography of Joseph Leidy for the Philadelphia Academy of Science. Dr. Dolley has spent the last two years in Japan and the Bahamas and will soon return to the latter islands where he is very much interested in fostering the study of marine flora and fauna.

The *Atlantis*, research ketch of the Oceanographic Institution, returned from a ten day cruise on Wednesday morning. Sailing under excellent weather conditions, it took up station about two hundred miles north of Bermuda for five days in order to take the temperature and salinity of the sea to a depth of about 2800 fathoms. Members of the crew were successful in landing a nine and one-half foot shark. The expedition had a good run home, arriving safely with its mascots, a mother cat and four baby kittens. According to Captain Fred S. McMurray the ketch made 238 miles on Tuesday, July 14. Dr. H. R. Seiwell was in charge of the trip.

The *Atlantis* will leave July 20 under the direction of Dr. Henry Stetson of Harvard for a week's cruise dredging in the canyons or gorges at the southern end of Georges Bank.

ADDITIONS TO THE DIRECTORY

Investigators

Clark, J. K. Trinity. OM 28. K 5.
duBuy, H. G. res. fel. phys. Harvard Med. Br 233. Robinson, Quisset.
Gilchrist, F. G. asst. prof. zool. Pomona (Claremont). Br 323. Cassidy, Millfield.
Itoh, H. grad. zool. Pennsylvania. Br 220. McGinnis, Quisset.
Kaufman, A. L. Franklin and Marshall (Lancaster). OM base. Rohmling, Pleasant.
Kehoe, Catharine E. grad. asst. zool. Oberlin. Br 218. Budington.
Kindred, J. E. assoc. prof. hist. and emb. Virginia. Br 106. D 311.
King, Jessie L. prof. phys. Goucher. Bot 4. A 305.
Kraatz, C. P. asst. zool. Cincinnati. Br 334. Dr.
Moment, G. B. instr. biol. Goucher. Br 217 J. Rogers. School.
O'Brien, Helen instr. res. med. Pennsylvania. Br 109 and 311. Young, West.
Robertson, Kathleen M. res. asst. exp. biol. Toronto. Br 107. H 6.
Strong, O. S. prof. neur. Columbia. Bot 5. Elliot, Center.
Wheeler, N. C. asst. phys. Purdue. Br 126. K 5.

The "General Greene," a member of the ice patrol coast guard, arrived at Woods Hole last Wednesday for a week's stay, with materials on board for the Oceanographic Institution. Although officially stationed at Woods Hole, the patrol boat is on almost constant cruise and rarely visits here. This week's stay is being utilized for a general overhauling of the boat.

Mr. Mervin Palmer, professor of botany at Butler University, Indianapolis, and Mrs. Palmer, are guests of the Rev. and Mrs. Kreke for a short time.

NOTES FROM THE TORTUGAS LABORATORY

The Tortugas Laboratory was opened for work on May 29. The men occupying tables and general titles of the subject of their researches are:

A. A. Boyden, Rutgers University, "Blood-relationships among Invertebrates."
H. H. Darby, College of Physicians and Surgeons of New York, "Process of Differentiation in Crustaceans."
M. W. deLaubenfels, Altadena, California, "Physiology of Porifera."
Caswell Grave, Washington University, "Chemical Accelerators of Metamorphosis of larvae of Ascidians."
F. R. Kille, Swarthmore College, "Regeneration in Holotheureans."
J. L. Leitch, University of California, "A Physico-chemical Study of Eggs of Echinoderms especially the Sea-urchins, with Special Emphasis on the Relationship between Chemical Composition and Water Exchanges."
Gordon Marsh, University of Iowa, "The Relation of Light to E. M. F. in Valonia."
C. E. Moritz, University of California, "Embryology of Mollusks and Crustacea."
Paul A. Nicoll, Washington University, (with Grave), "Chemical Accelerators of Metamorphosis of larvae of Ascidians."
H. H. Plough, Amherst College, "Self Sterility and Self Fertilization in the Ascidian, *Polycarpa obtecta*, and Related Species."
B. H. Willier, University of Rochester, "A Study of the Early Embryology of the Loggerhead Turtle and of Sharks."

Others expected during the second half of the season are:

L. R. Cary, Princeton University
F. R. Pitts, New York University
D. H. Tennent, Bryn Mawr College

It is hoped that Dr. W. H. Longley will again be able to assume charge of the Laboratory before the season closes; in his absence Professor Caswell Grave has been serving as acting executive officer.

DEAD WHALES ON THE BARNSTABLE DUNES

Dr. William Ballard, assistant professor of biology, Dartmouth, visited a colony of black-crowned night herons last week and discovered a number of whales which were driven ashore last year on the north side of Sandy Neck, otherwise known as Barnstable Dunes. Because of their flabbiness, the whales had been stranded on the beach and had slowly expired. He found a clean skull which he brought home.

Others being interested, he led a party of M. B. L. investigators back; the group consisted of Dr. Samuel E. Hill, Dr. Alfred M. Lucas, Gardiner Moment, and Dr. William Puckett. The whales were between 15 and 18 feet long, as far as the party cared to investigate. They were well-preserved, but sensitive workers at the M. B. L. will testify to death at some long past date. In the two miles which were covered, five whales of the tooth variety were found.

The party brought home two more skulls, besides a flipper and neck verterbrate. Dr. Ballard's whale skull is drying and incidentally airing on the roof of the main building preparatory to its trip to the Dartmouth Museum. —E. T.

"Crab Apple" by Theodore Packard is the play which has been selected by the Penzance Players for their summer presentation. Written by a Yale drama student, this play has been presented only in New Haven and in summer stock; it will not be produced in New York until next season. In fact, neither the publisher, Samuel French, nor the playwright himself had an available script for the players. Anxious to start immediately, Miss Peggy Clark, technical adviser and member of the Executive Board, motored down to Metunik, Rhode Island, where the Yale drama school runs the Theatre-by-the-Sea. This group was giving the play, and from them Miss Clark obtained a script with which to start rehearsals. Try-outs will be held early this week and talent outside the group will be considered.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 18	4:35	4:42
July 19	5:23	5:30
July 20	6:05	6:19
July 21	6:48	7:04
July 22	7:30	7:52
July 23	8:12	8:35
July 24	8:58	9:25
July 25	9:40	10:16
July 26	10:29	11:10
July 27	11:24	
July 28	12:03	12:15
July 29	12:59	1:06
July 30	1:53	1:57
July 31	2:43	2:51
August 1	3:32	3:41
August 2	4:14	4:27
August 3	4:58	5:10
August 4	5:44	5:57
August 5	6:28	6:49

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

BOTANY CLASS NOTES

Mr. Earl T. Rose of the Iowa State Conservation Commission spoke on his work with blue-green algae in Iowa lakes at the botany seminar on July 13. The lakes in Iowa are quite alkaline, and those which are heavily polluted are infested with blue-green algae such as Aphanizomenon, Anabaena, and Microcystis. These organisms produce what are known as "water-blooms." The decomposition of these algae causes decidedly unpleasant odors and decreases the oxygen supply considerably. The fish are killed, swimming and boating are made practically impossible, and the drinking water situation becomes an important problem. Mr. Rose worked with copper sulphate and was able to control the algae growth to a considerable extent. He also studied the life history of Aphanizomenon while working on this project.

After Mr. Rose's talk, Dr. Drouet continued his illustrated talk on his trip to Brazil. . . . Tea was, of course, an important part of the evening's program. . . . On Sunday, 80 % of the botany class descended on various parts of Cape Cod, with the intention of having a holiday. But somehow, they couldn't leave Woods Hole without their pails—and the pails came back full of interesting specimens. There were also some grand "Kelps" and two insects—a rhinoceros beetle and an unidentified bug with lovely green wings. . . . Our Tuesday field trip had to be postponed due to rough weather. However, the sandwiches were almost as good on Wednesday, and the field trip was a great success.

MARTHA THURLOW.

EMBRYOLOGY CLASS NOTES

(Continued from page 73)

goodly feed was followed by solicited exhibitions of talent. Of course there was a baseball game and of course there was harmony (with some Irish element) on the homeward voyage.

The faculty and guests included Dr. Packard, Dr. Schotté, Dr. Grave, Dr. and Mrs. Hörstadius, Dr. Holtfrater, and Miss Rebecca Tyson (visiting Miss Hummell of the embryology class). D. de F. BAUER.

THE SCIENTIFIC WORKERS AT WOODS HOLE AND 1000 SUMMER COLONISTS

An exclusive shopping center has developed at a point about a quarter of a mile north of the center of the town of Falmouth, which is sometimes overlooked by individuals who are in Woods Hole for the first summer. It is natural that the average person would tend to make his purchases in the center because that is where he is most likely to go for other reasons. We are convinced, however, that discriminating people who once become acquainted with the select shops, some of which are branches of the large Boston stores, will frequently visit The Buyway.

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SEALS AND SENTIMENTAL SCIENTISTS

The baby seals of the Fisheries enclosure, "puppies" to the initiated, fill a unique rôle in the life of Woods Hole. If one were to calculate their value to society, these versatile creatures would rank as high as many an example of a so-called "higher" genus at Woods Hole.

Behind that benign, world-wise, though yet so young, exterior lies a wealth of material for data on respiration during deep sea diving, etc., for the scientist. Yet there is more to their rôle than that. What person present at Dr. Laurence Irving's seminar "Some respiratory characteristics of the seal and their relation to diving," when this Canadian scientist opened his talk on respiration with a reference to the seals of the Fisheries enclosure, could help but feel the warm wave of sympathy and good nature that swept over that usually cool and reserved audience. For, if the truth be known, the seals have helped to humanize the scientists. Whole droves of laboratory workers make daily pilgrimages to the enclosure, and those bored souls, who, in a moment of weakness consented to accompany their "seal fan" friends, often themselves succumb to the charms of the plump lazy little devils. Investigators lean against the railing in rapt attention, eyes fixed upon the sleek, usually motionless forms at rest upon the softly rocking float. The least quiver of motion, the least flicker of an eyelash, is rewarded with ingenuous sighs of delight. When the seals on rare occasions stretch to their full length, arch their backs, and with a tremendous yawn, describe a complete circle, tip of nose touching tip of tail, the devotees know perfect joy.

Excitement runs high when, with an expert wiggle and a rapid flip-flap of flippers, as comical as it is unexpected, one of the "puppies" takes to the water. A mildly surprised and quizzical expression momentarily appears in the eyes of the remaining "puppy," who contemplating such exertion at first with mild disapproval, later thinks better of it and joins his playmate in the water.

Perhaps it is their very youth that so captures the hearts of the onlookers. Perhaps it is the thought of these two lost little creatures so removed from heir normal environment, so artlessly furnishing a Roman holiday for the onlookers, that transforms matter-of-fact scientists to shameless sentimentalists. As the sun begins to set on the baby seals hemmed in by grim stone, the charming "Seal's Lullaby" of Kipling recalls to mind their freer, happier brothers and sisters:

Oh hush thee my baby, the night is upon us
And black are the waters that sparkled so green.
The moon o'er the combers looks downward to find us
At rest in the hollows that rustle between.

Where billow meets billow
There soft be thy pillow.
Ah, weary wee flipperling
Rest at thy ease.

The storm shall not wake thee
Nor sharks overtake thee,
Asleep in the arms of the slow swinging seas.

Rita Guttman.

TROUT LAKE LIMNOLOGICAL LABORATORY

Dr. C. Juday, Director

(August 31, 1935)

DIATOM INVESTIGATIONS

A study of the diatom flora of the lakes of northeastern Wisconsin is being made by Dr. Paul S. Conger, Research Associate of the Carnegie Institution of Washington. Up to the present time collections have been made from different depths in more than 40 lakes. The lakes selected for this investigation vary widely in chemical content, and also in physical and topographic features. One of the main purposes of the study is to determine the specific ecology of characteristic species of diatoms that are found in the Trout Lake region. Additional lakes in the district will be studied in subsequent years as well as those in other parts of the state.

Some other phases of this diatom research upon which studies are being made simultaneously are the relative abundance and quantity of diatoms in soft and hard water lakes, the method of sedimentation and composition of the lake sediments, and the dissolved silica relationships in those lakes that have a very low mineral content. A marked difference of diatom flora has been noted in the soft and medium hard water lakes of this region and the much harder water lakes of the southeastern part of the state, but more information is desired on this point. The type and extent of response of the diatoms to experiments on the fertilization of the water of Weber Lake by other members of the Laboratory staff will also be studied.

Dr. J. P. Warbasse of Penzance Point will hold a Penzance Forum at his home on Sunday, July 19, at 3:30 in the afternoon. The subject of the meeting will be "The Cooperative Movement" and will be discussed by Dr. J. P. Warbasse of the Cooperative League, Mr. R. N. Benjamin of National Cooperatives, Inc., and Mr. T. W. Metzger of Pennsylvania Cooperatives.

Dr. Rufus Weaver, noted anatomist of Philadelphia, died in his ninety-sixth year on July 15. Dr. Weaver had been a member of the faculty of Hahnemann Medical College which was formerly known as Pennsylvania Medical College. Dr. Weaver was distinguished for his work in the dissection of the human nervous system.

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THE SIGNIFICANCE OF MID-BODIES

Dr. Henry J. Fry
Visiting Investigator, Department of Anatomy, Cornell University Medical College

Mid-bodies are generally regarded as a vestigial homologue of the cell plate of plant cells, persisting in many animal cells. The hypothesis is here suggested that they are phenomena of focalization—the places where the spindle fibers are pinched together by the cleaving cell—and that they have no existence as individualized cell components.

They may be present or absent in cells of the same type in closely related species, depending upon whether or not the spindle is still present when division occurs. In different cell types of the same species they may be rings, minute dots, irregular masses, or exhibit other configurations. Their size and structure is closely related to the detailed manner in which the spindle is focalized. They often differ from cell to cell of the same kind on the same slide. If cells which ordinarily have mid-bodies are subjected to environmental modifications causing the spindles to disappear just prior to cleavage, no mid-bodies arise. If the fixative employed demonstrates coarse spindle fibers, mid-bodies are relatively large; if delicate ones are shown, they are small or absent, the details differing widely under different conditions.

The conclusion is therefore suggested that focalization of the fibers at the mid-region of the spindle often involves the formation of minute, sharply demarked structures which look like individualized cell components, but which are actually phenomena of focalization. If this conclusion is valid, we must carefully consider the nature of those bodies which occur at the ends of the spindles, where the spindle-fibers, and in many cases, astral rays, are also focalized. It is suggested that in many cells the supposed central bodies are, like mid-bodies, transient phenomena of focalization, and not individualized cell components. This suggestion, of course, has no significance for those central bodies which are also blepharoplasts, and certain other classes, which are stable structures, and exist in complete absence of areas of focalization.

The fact that when the spindle is pinched together, mid-bodies appear at that place, indicates that it is not homogeneous in structure, as it generally appears to be in the living condition. If it were homogeneous, the pinching should not result in the formation of bodies. That they do occur supports the conclusion that the living spindle has some kind of linear organization.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 13, 1935.)

A VERY RARE SPECIMEN FOR WOODS HOLE

George M. Gray
Curator of Museum, Marine Biological Supply Department

About August 13th, Mr. Wamsley, the veteran preparator at the Supply Department, brought to me a specimen with which he was not familiar, and which one of the collecting crew, Mr. Riggs, had dug on one of the trips to Naushon Island. It proved to be, as at first surmised, *Caudina arenata,* or "Tailed" Holothurian, one of the very rarest of the Holothurians of the Woods Hole region.

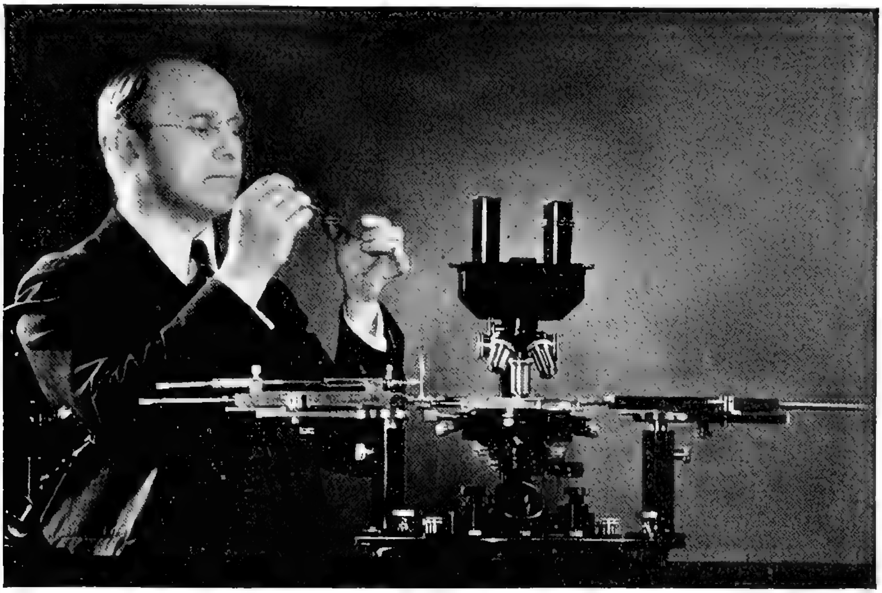
This specimen was of a flesh color, deepening to pink at the anterior end. It was about $3\frac{1}{4}$ inches long and a little over $\frac{1}{2}$ inch in diameter at the anterior and larger end. This tapers back to form the "tail" which latter is $^{1}/_{16}$ inch in diameter at the end. Of course the animal can change its shape to some extent, but this is the normal form.

The *Caudina arenata* was the first living specimen I had seen of this creature, and I was overjoyed to have the pleasure of adding it to the Laboratory Museum. It was placed in a finger bowl of clean sea water where it gradually put forth its tentacles, about fifteen in number. These were rather short, each one terminating in four finger-like tips. After the animal was narcotized, it was preserved and is now on exhibition in the Laboratory Museum.

As stated above, it is very rare in the Woods Hole region. According to Dr. H. L. Clark, it was admitted to this locality on the strength of Professor Verrill's report (73b) that Professor Webster took it at Woods Hole, and on the existence of three small specimens in the collection of the U. S. National Museum, labeled "off Cuttyhunk $18\frac{1}{2}$ fathoms."

Sumner in his "Biological Survey" mentions "Lower half of Buzzards Bay: 8 records; dredged in 6 to 13 fathoms. One record mouth of Vineyard Sound, $17\frac{1}{2}$ fathoms, sand." He also mentions several other dredging stations where a few were taken.

Caudina arenata sometimes washes up on Revere Beach after heavy storms, and I think it has been taken at or off Block Island by a Mr. Sanford. I believe it has not been taken by any of the Invertebrate classes, and I have not known of its being taken before on any of the shore or dredging trips of the Marine Biological Laboratory staff. This particular specimen was taken on the flats, in shallow water (about a foot deep) at Naushon Island.



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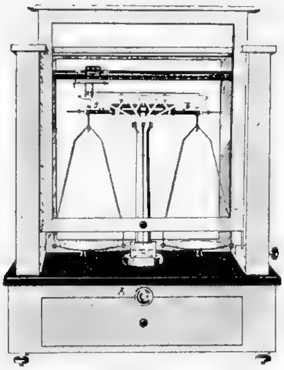

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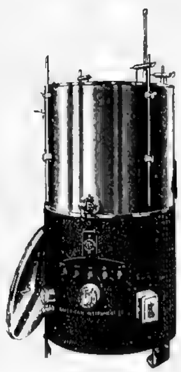

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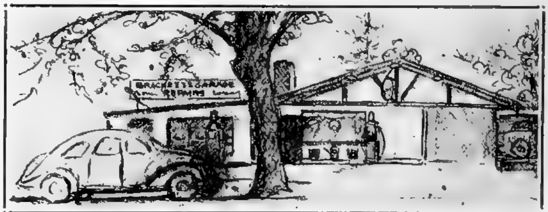

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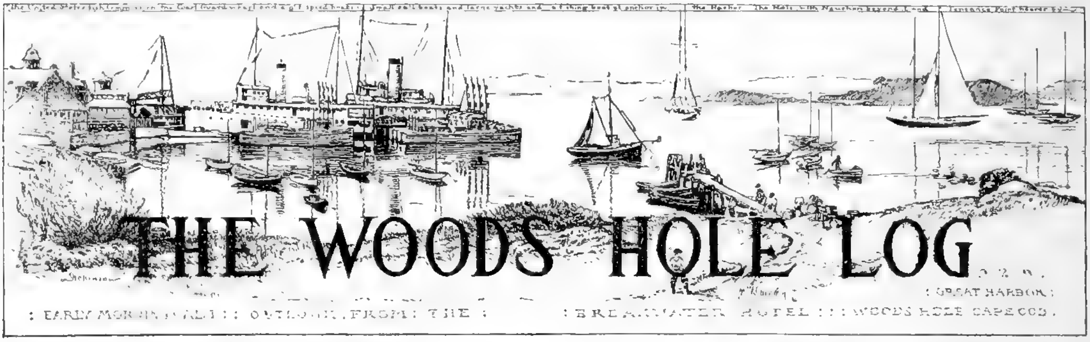

WOODS HOLE LOG SCHOLARSHIP FUND

The Woods Hole Log a while ago announced a scholarship fund the money from which is to be given to a Woods Hole boy or girl who has completed his high school education and who wishes to continue his studies either at college or take training in some special field such as music, painting, or in one of the trades.

The following individuals have consented to serve on a committee to handle the funds and award the scholarships:

Mr. Paul Dillingham, Superintendent of Falmouth Schools, Mr. Walter Luscombe, Mr. Charles E. L. Gifford, Mr. J. W. Vallis, Mrs. Robert Veeder, Mrs. Oscar Hilton, Mr. Henry Haddon, Mr. Samuel Cahoon.

A year or two ago *The Woods Hole Log* made an initial gift of $25.00 to the scholarship fund; this money will be available for award next fall. In addition, ten per cent. of the receipts of all local advertising in The Collecting Net during the present summer will be turned over to the scholarship committee in the beginning of September. Last year the total value of the local advertising was $501.22. We shall certainly have as much local advertising as last year and thus the committee can be assured of having $80.00 to award in September.

The decision as to whether the scholarships shall be awarded as $50.00 scholarships or $100.00 scholarships rest with the committee.

We believe that in the same way that The Collecting Net has been able to build up its scholarships for laboratory students that sooner or later it might be equally successful in accumulating a number of small sums that would be a definite contribution to the residents of Woods Hole. In this connection it does not seem out of the way to remark that individuals who purchase from the stores advertising in The Collecting Net are making both a direct and an indirect contribution to the scholarship fund. We therefore take the liberty of asking our readers to pay special attention to the advertisements contained in this issue with the hope that they will give the firms taking space special attention when purchasing goods or service.

THE TRAFFIC SITUATION IN WOODS HOLE. II.

I understand that my note in the last issue of The Collecting Net has initiated a certain amount of discussion concerning the advisability of permitting cars to park on the south side of Main and Water Streets. That is what is was supposed to do! Chief Baker, upon having my letter of last week called to his attention, said that he had given a great deal of thought to the parking situation in Falmouth and Woods Hole (as indeed he has) and that he always sought to compromise between the conflicting wishes of the owners of the cars at rest and those in motion. The latter group must, for any given day, be in the majority. May we suggest to Chief Baker that he take a vote on Saturday afternoon, polling both groups—and then let his conscience be his guide! —*C. N.*

On Sunday afternoon a Ford cabriolet driven by Evelyn Thompson from Worcester, Massachusetts, crashed into a telephone post on a curve on the Sippewissett Road near the Cape Codder Hotel. The owner of the car, Dr. Donald K. McClusky, also of Worcester, was a passenger in the car.

The left front end of the car was demolished and the windshield broken. Both occupants were injured and medical attention was promptly given at the Cape Codder where both persons were in residence.

The impact of the car against the telephone post shifted the latter several inches to the East. Photographs were taken by one of the investigators at the laboratory after the incident; if they turn out well one will be printed in the next issue of The Collecting Net.

Mr. and Mrs. Charles T. Crocker, 3rd, have rented Walter O. Luscumbe's cottage on Nobska Road. Their son, Peter, and two daughters, Patricia and Mary, are expected to arrive soon with Mrs. Crocker.

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NOTES

Starting Wednesday, July 22, Dorothy Gish will star in "Russet Mantle" at the Silver Beach Theatre. Jay Fassett will have the same rôle which he took in the original production of Lynn Riggs' popular work on Boardway this winter. Ben Smith, formerly cast in Jane Cowl's starring vehicle, "Rain from Heaven," and his wife, Margaret Douglass, have important rôles. Edmonia Nolley of "The Children's Hour," Charlotte MacAleer, and Marshall Grant comprise the rest of the cast.

The Downie Brothers Circus gave two performances on the Scranton Avenue grounds, East Main Street, Saturday, July 18, at 2 and at 8 P. M. The biggest motorized show in operation, the circus came to Falmouth from Hyannis; it will open next in Newport.

In spite of variations in the weather the Choral Club under Mr. Ivan T. Gorokhoff has had a large and enthusiastic group at each of its Tuesday and Thursday evening meetings. Miss Mildred S. Wilcox, music teacher at the Art School, is accompanist. At the last Tuesday meeting twenty people gave $1.50 each for music.

St. Joseph's Church held its weekly whist and bridge party last Wednesday night. Prizes for high and low score for both men and women in bridge and in whist were awarded. Refreshments were served after the card playing ceased. At the future Wednesday meetings only whist will be played, Father McLean announced.

The Methodist Episcopal Church gave a lobster supper last Wednesday night in the vestry of the Church under the auspices of the Women's League.

The W. P. A. Circus which came to Woods Hole last Wednesday provided free entertainment which was particularly enjoyed by the children. The acts consisted of juggling, bicycle acts, death defying aerial stunts, hoop manipulation, and a number of clowns who amused the children very successfully by their antics.

Miss Anita Luscombe, while sailing the *Mogul* to Quisset, side-swiped another boat and cracked the *Mogul's* mast. The damage is estimated at $800.00.

Miss Rosemary Crocker of Fitchburg, Mass., who has been visiting Miss Anita Luscombe at the home of her grandparents the Walter O. Luscombes, left Woods Hole last week. Miss Crocker is the daughter of Mr. and Mrs. Bigelow Crocker.

THE SEEING EYE

Last Wednesday night at the Woods Hole Golf Course Club House an explanation and demonstration of the "seeing eye" was given under the direction of Miss Gretchen Greene.

Talking to a large audience, she told the story of how these German shepherd dogs came into prominence in America. In Germany shortly after the war, Mrs. Hustas saw dogs successfully leading blind men about. Becoming interested in the idea, she studied the methods used and opened a training school in Switzerland. She then decided to devote all her time to training in America and moved her headquarters to Morristown, New Jersey.

The remarkable part of it, the lecturer explained, is that these dogs actually become the eyes of the blind person, conducting him wherever he needs to go—through traffic, up and down curbs, steps and inclines and even around low hanging objects such as awnings if the man is too tall to clear them. A slight tug by the dog on the harness-like leash, which the blind man holds in his hand, gives the necessary warning.

The training of these dogs, she continued, costs only $150.00 which may be paid over a period of five years. The additional amount is supplied by contributions from interested parties and from blind people who have been successful in earning a living. If the dog dies within three years, it is replaced without cost; if the blind person dies, the dog is returned and retrained. No children or people over 55 are allowed to take them because they have not the strength to handle the dog.

There have been only two accidents in the U. S. to people using these dogs, Miss Greene cited, and neither of these was the dog's fault. In one case a drunken driver hit a blind man; his dog saved his life by grabbing him and throwing him back. In the other a truck skidded and injured both man and dog.

The speaker told of many cases where blind people have been able to earn their living through the aid of these dogs.

In connection with the talk she presented a movie showing the successive steps of training from the beginning until the person and the animal are able to work together. Three years are required for the education of a trainer, three months for a dog, and one month for a man.

E. T.

Sergeant John F. Harrison of Dorchester, member of the Massachusetts Military Reserve, was killed by a bolt of lightning Saturday morning July 11 at the National Guard camp at Sandwich. He is survived by a widow and infant daughter.

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THE COLLECTING NET

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CULTURE METHODS FOR ASCIDIANS

Dr. N. J. Berrill
Associate Professor of Zoology
McGill University, Montreal

Methods of Capture

Ascidians are sessile organisms varying considerably in habitat. Many forms are littoral, to be found in greatest quantity immediately above or below the low water spring tide level. Others may be found attached to the under surface of floating objects, while many forms are found only in deeper water attached to rocky or hard surfaces, or embedded in sand or mud without any strong attachment. In general the ideal habitat for ascidians is one in which there is a considerable natural flow of clear water, yet not sufficient water movement, such as wave action, to dislodge the animal. This habitat will vary according to the size of the animal and its relative area of attachment.

Compound ascidians as a rule tend toward a two-dimentional state with a maximum area of attachment and minimum thickness. Such forms may be found in profusion on the under surface of rocks and stones in the lower intertidal zone and upper littoral; (*Continued on page* 95)

M. B. L. Calendar

TUESDAY, July 28, 8:00 P. M.

Seminar: Dr. Gertrude Evans: "The relation between vitamins and the growth and survival of goldfishes in homotypically conditioned water."

Dr. C. P. Kraatz: "A possible endocrine rôle of the eosinophil leucocytes in the female rat."

Dr. J. E. Kindred: "An interpretation of the secondary lymphoid nodule."

Dr. Laurence Irving: "Physiological adjustments to diving in the beaver."

FRIDAY, July 31, 8:00 P. M.

Lecture: Dr. Sven Hörstadius: "Researches on determination in the early development of the sea-urchins."

RECENT STUDIES IN MASS PHYSIOLOGY

Dr. W. C. Allee
Professor of Zoology,
The University of Chicago

Over-crowding, which is one aspect of mass physiology, is easily demonstrated and has been much studied. The emphasis in this lecture was largely on the less well known phenomena associated with under-crowding. When under-crowding occurs, the optimum population density lies at some point above the minimum. When over-crowding is found without associated under-crowding, the optimum and minimum populations coincide.

Mass effects associated with under-crowding are widely distributed in nature and occur at all levels throughout the animal kingdom. The main discussion centered on some of the analyses of mechanisms which underlie physiological disturbances when experimental populations are reduced below their optimum.

Among the cases discussed in some detail were examples of mass protection when (a) toxic substances such as colloidal silver or calcium chloride are added or (b) when the lethal effect is produced by extreme hypotonicity of the medium. Experi-

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AERIAL VIEW OF PENZANCE AND THE ISLANDS TO THE SOUTH

The south end of Nonamassett appears in the foreground with Sheep Pen Cove on the right. The islands reading from the foreground to the background are: Pine, Devil's Foot and Ram Islands. The ribbon of land in the background is Penzance Point; the tip of Dr. Warbasse's estate can be seen at the extreme left.

mentally tested explanations were also advanced which cover many of the causes that frequently lead to an increase in rate of division in infusorians when more than one organism is seeded into the culture medium (Robertson's effect), and when in the confused flour beetle, *Tribolium confusum,* two, rather than more or fewer pairs, reproduce most rapidly in a given quantity of flour.

At low temperatures, and perhaps under other conditions, inbred strains of mice grow more rapidly when optimal numbers are present than when they are isolated or more crowded. This growth-promoting effect of optimal crowding disappears at higher temperatures.

Goldfishes grow more rapidly in artificial pond water, and in the natural waters tested, if the water has been previously "conditioned" by the presence of other goldfishes. This growth-promoting effect is largely the result of food particles regurgitated by the conditioning fishes or to the food value of the faeces or both. Growth of goldfishes has also been stimulated by adding a protein extract from the surface of other goldfishes even when the dilution is as great as 1:800,000.

These cases of under-crowding were not chosen for comment because they are isolated instances, rather they were selected from many similar mass effects in which progress has been made in the analysis of underlying causes. These recent tests leave little room for the various sorts of X-substances frequently suggested as the causal agents in mass effects both of under- and over-crowding.

With regard to the larger aspects of the questions involved, these modern studies of optimal population densities give the strongest existing evidence that the principle of automatic cooperation has general application. Consideration of cooperation as a biological principle is not new; the idea was already a seasoned one when Espinas in 1878 attempted to marshall evidence to prove its wide spread existence and fundamental importance in biology. Kropotkin, Deegener, Patten, and especially Wheeler, have written in the same vein.

All these men labored under a decided handicap in their emphasis on the importance of cooperation. Sexual reproduction, and for some unknown reason, hibernation aside, the general field and laboratory experience of naturalists and scientists alike, was that crowding was uniformly harmful in its effects. Only when, by some unexplained process, groups became sufficiently well organized so that there was increased likelihood of warning of danger and/or protection from it, did cooperation become obvious.

For lack of knowledge of other possible preliminary steps, the origin of cooperative societies was thought to center wholly about phenomena associated with sexual reproduction. For this or other reasons, even the able work of Espinas and Wheeler has not won suitable appreciation of the general application of this principle of biological cooperation at the automatic level. Thanks to the relatively recent discovery in various parts of the world of previously unsuspected positive survival values associated with optimal numbers, and thanks further to the experimental working out of relatively simple mechanisms whereby cooperation, or its subconscious equivalent, may be brought about even among simpler animals, it now seems possible that biologists and even laymen may finally accept the general importance of this principle approximately as Espinas stated it nearly sixty years ago.

CULTURE METHODS FOR ASCIDIANS

(Continued from Page 93)

a few species may be attached to algae and eel grass in the same region. Solitary ascidians are usually larger and possess a relatively smaller area of attachment. Their size and water requirements alone may prohibit their attachment to such surfaces as are occupied by the majority of compound forms, and they are more typically to be found attached to the sides and upper surfaces of rocks, large stones, wharf piles and under surface of ships and floats, etc., though very rarely above and often much below the low tide level. Mud and sand flats at some depth are typical habitats of some species of Molgula and Polycarpa, although they become attached to rock surfaces in very sheltered positions.

The principal methods of capture are thus three-fold, turning over boulders at low-tide level, often necessitating the use of a crow-bar; scraping piles, rocks and ship-bottoms with long-handled net-scrapers and dredging.

The following is a list of the more common ascidians of American coastal waters, together

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TABLE I.

All the following species are common shallow water forms; those marked with an asterisk are viviparous; for further information concerning distribution, habitat, and identification, references 3, 10, 11, 13-16 should be consulted.

Species	Distribution	Egg Size in mm.	Breeding Season
Ciona intestinalis	Alaska—S. Calif. Cape Cod	0.17	Depends on size of individual.
*Perophora viridis	New England—Florida Bermuda	0.24	Aug.-Sept.
*Perophora annectens	Vancouver—S. Calif.	0.24	July-Sept.
*Perophora bermudensis	Bermuda	0.24	Sept.-Oct.
*Ecteinascidia turbinata	Bermuda—Tortugas	0.72	June-Aug.
*Ecteinascidia conklini	Bermuda—Tortugas	0.58	July-Sept.
Ascidia prunum	New England—Fundy	0.18	Not seasonal, depends on size of individual.
Ascidia hygomiana	N. Carolina—Tortugas	0.17	
Ascidia nigra(atra)	Bermuda—Tortugas—Fla.	0.17	
Ascidia curvata	Bermuda—Tortugas	0.17	
Styela partita	Massachusetts Bay—Florida—Bermuda	0.15	June-Sept.
Styela plicata	N. Carolina—Florida	0.16	June-Sept.
Polycarpa obtecta	Bermuda—Tortugas	0.18	May-Sept.
*Polyandrocarpa tincta	Bermuda—Tortugas	0.21	May-Sept.
*Symplegma viride	Bermuda—Tortugas	0.44	June-Sept.
*Botryllus schlesseri	S. New England	0.42	June-Sept.
*Botrylloides niger	Bermuda—Florida	0.26	June-Aug.
*Tethyum pyriforme	Maine—Fundy	0.26	July-Aug.
Boltenia ovifera	Maine—Fundy	0.16	July-Aug.
*Boltenia echinata	Maine—Fundy	0.18	July-Sept.
Pyura vittata	Bermuda—N. C.—Fla.	0.16	Summer
Molgula retortiformis	Maine—Fundy	0.18	Probably no definite season, individuals above a certain size breeding continuously.
Molgula manhattensis	New England—N. Car.	0.11	
*Molgula citrina	Fundy—Long Island	0.21	
*Molgula verrucifera	California	0.13	
Molgula occidentalis	N. Car.—Florida	0.11	
Eugyra pilularis	Fundy—New England	0.11	
*Clavelina picta	Bermuda	0.48	July-Sept.
*Clavelina huntsmani	Vancouver—S. Calif.	0.26	June-Sept.
*Eudistoma olivacea	Bermuda—Florida	0.30(?)	July-Aug.
*Eudistoma lobatum	California	0.30(?)	Summer
*Distaplia clava	New England—Fundy	Circa 0.40	June-Aug. Summer
*Distaplia bermudensis	Bermuda		
*Distaplia sp.	California		
*Aplidium pellucidum	Cape Cod—Florida	Circa 0.30	Summer
*Aplidium sp.	California		

with their habitat, distribution and the breeding season in so far as it is known.

Breeding Seasons

The breeding season for ascidians of both the Pacific and Atlantic coasts, including the West Indian fauna typical of the Gulf of Mexico, seems to be summer. Certain forms, namely the various species of Ascidia and probably Molgula and Ciona have no definite season; individuals above a certain size are sexually mature and may breed throughout the year, although the lower temperatures of winter retard the rate of egg production. Most compound ascidians are actively budding during the winter and the individual zooids do not attain sexual maturity until early summer. Some solitary forms such as Styela and probably most species of the families Styelidae and Pyuridae have a breeding season limited to summer months. With the exception of Styela partita, the polystyelids *Boltenia echinata* little is known concerning the members of these two families from this point of view.

The breeding season so far as is known for the species most available is given in the table, though it should be remembered that it may extend earlier or later and may vary in different localities.

Procuring of Eggs or Embryos

For purposes of rearing, and developmental studies in general, ascidians are to be divided into two groups according to whether they are oviparous or viviparous. The occurrence of these two kinds is indicated in the table. Except in a very few instances oviparous ascidians are comparatively large and produce a great many small eggs, viviparous ascidians are small and produce a small number of comparatively large eggs. Thus in one case rearing methods must start with the unsegmented egg, in the other with the active tadpole larva. Only after the tadpole larvae have become attached does treatment become the same for both kinds.

a. Oviparous Forms.

In Ciona and in the species of Ascidia there is a long oviduct, accompanied by the sperm duct, that extends from the gonad to near the atrial siphon. Once the individual becomes sexually mature the ova enter the oviduct and there accumulate, the eggs being shed periodically. Since the germinal vesicle ruptures as the ova pass from the ovary into the oviduct, all the eggs in the duct are ripe. In some species of Ascidia, especially those that tend to become exposed at low tides to the warmer temperature of the air, a large percentage of the eggs in the distal part of the oviduct may be dead. (1) Eggs from the middle or proximal part of the oviduct are in any case less likely to be over-ripe.

To obtain the eggs and sperm the test should be removed, the wall of the oviduct or sperm duct punctured with fine scissors and the germ cells withdrawn in a pipette. This is much more satisfactory than maintaining the parents in aquaria and waiting for them to spawn naturally.

A similar procedure may be followed in the case of the oviparous species of Molgula (and Eugyra), although the oviduct is short and confined to the central part of the gonad, so that this method is likely to result in the extraction of immature as well as ripe eggs. As unripe eggs are more resistant generally than ripe eggs, fertilized or unfertilized, this is no serious drawback as active larvae can be segregated.

Such a method used with oviparous styelids and pyurids is only occasionally successful, and it is better to maintain the adults in aquaria and collect the eggs as they are spawned and fertilized in the water. In the case of Styela partita spawning occurs at sundown, (7) and this may be so for the majority.

b. Viviparous Forms.

Viviparous species vary considerably in egg number and egg size. In some species almost all embryos will be at the same stage of development, as in Botryllus, Polyandrocarpa, Boltenia echinata and Tethyum pyriforme. (5) In most species embryos at all stages of development are to be found. In both groups embryos extracted before the attainment of the tadpole stage will not continue development unless certain precautions are taken. If the developmental stages desired are those of the tadpole or later it is always safer to keep the parents alive in aquaria until the tadpoles are liberated. Alternatively the embryos may be extracted and those tadpoles exhibiting signs of activity segregated. In the first method the risk is that the parent animals will not live long enough, in the second that they may not contain tadpole larvae sufficiently mature.

Rearing of Embryonic Stages

Until the tadpole stage is passed and metamorphosis completed to form a small ascidiozooid that is attached and has open siphons and active stigmata, no food from external sources is needed.

a. Oviparous Forms.

Eggs and sperm are extracted from ducts after removal of test, followed by artificial fertilization. Some species are self fertile, others self sterile, others e.g., Ciona, vary with locality. In any case better cultures are obtained by cross fertilizing. A small quantity of sperm is mixed with the eggs in a finger bowl of sea-water and proper mixing ensured by pouring from one bowl to an-

other several times. After fifteen or twenty minutes the eggs should have been fertilized and will lie at the bottom of the vessel. As much of the supernatant water as possible should then be siphoned off and replaced with clean water, the process of allowing the eggs to settle and replacing the water being repeated several times to ensure complete elimination of all surplus spermatozoa. Failure to do so leads to abnormal development. Development up to the tadpole and beyond can take place in fingerbowls, but vessels holding a larger volume of water are much more satisfactory. If large cultures are desired in a limited volume of water, bubbling air through the water during development should ensure normal development. In the case of Ciona such procedure is advisable in any case as development in this form is very prone to become abnormal during the period of tail elongation.

If the early development of Ciona or Ascidia is to be studied the egg membranes may be removed in the following manner. (4) Unfertilized eggs are placed in a vessel of sea water containing crustacean stomach juice (not liver extract) in a proportion of about one part stomach juice to fifty or one hundred parts of sea-water. This medium digests off the membranes in the course of a very few hours (usually two or three) and on complete replacement of the water by clean seawater the eggs can be fertilized. Eggs remain viable for about eighteen hours after extraction. The method will not work with eggs that have been fertilized as it affects the surface tension of the dividing eggs. Slight shaking, or decanting from one vessel into another, during early cleavage stages will suffice to separate blastomeres without resort to the use of Calcium-free sea water.

b. Viviparous Forms.

The embryos of viviparous ascidians extracted before the attainment of the tadpole stage usually stop developing. A percentage at least will continue to develop under the following conditions. (5) A glass T-piece is attached to the stem of a thistle funnel, the whole is immersed in seawater and air bubbled slowly through the T-piece so that a slow current of water passes into the mouth of the funnel. This is arranged so that the mouth opens downwards. A piece of coarse bolting silk on which rest the embryos is attached to the mouth of the funnel. The embryos are thus kept mildly agitated in a gentle stream of water. For complete success the carbon dioxide tension of the water needs to be increased slightly. (6) Whenever possible it is better in the case of viviparous species to start cultures with the tadpole stage. It is not essential that the active stage be used for in most forms immature tadpoles showing but a trace of sensory pigment will continue development outside the parent.

Rearing of Post-Larval and Young Adult Stages

In order to rear later stages of ascidians it is essential that the tadpole larvae become properly attached to some surface. Tadpoles that fail to become attached, while they may metamorphose perfectly, will not continue development and growth. Most swimming tadpoles if kept in a large vessel of sea-water, such as an inverted bell-jar will become attached. It is often an advantage to lay flat pieces of glass in the vessel so that the forms which become attached to them can be studied without damage.

If tadpoles have been reared in small vessels they should be transferred to the larger vessels in which they are expected to become attached and grow while still actively swimming. An alternative method to the use of large culture vessels is to submerge glass plates to which larvae are attached in the sea in such a position that water movement will not dislodge the larvae and detritus will not accumulate on the plates. (12)

In large vessels the water should not be changed once the larvae show open siphons and functional stigmata. Replacement with water that presumably is in better condition is rarely tolerated, so that it is important that the water used in the first place should be of excellent quality.

Only after attachment and when the siphons and stigmata are functioning do ascidian larvae need food from external sources. A mixed assortment of small diatoms and algae etc., has been found to be at least as satisfactory as a pure culture of Nitschia, so merely a coarse filtering of water to remove the larger organisms is all that is necessary. A small quantity of sodium nitrite and sodium phosphate should be added to the water from time to time in order to ensure continued multiplication of the food organisms. The ascidians will suffer if the growth, especially on the walls of the vessel, becomes too thick. This may be controlled by limiting with shades the amount of light that reaches the vessel. A slight circulation produced by the slow bubbling of air through the water is an advantage, but is by no means essential. Under these conditions it should be possible to rear most ascidians to a comparatively large size, even to maturity.

pH Requirements

It is most unlikely that the pH of the water will fall to so low a value that development or growth becomes affected. Only when the pH falls to 7.0 does development tend to become abnormal and hatching in Ciona and Ascidia inhibited. (1) In the other direction normal de-

velopment is possible up to a pH of 9.0. There is considerable danger however, that a luxuriant growth of algae may cause the pH to rise to even higher values, especially if small culture vessels are used. Tests should accordingly be made at intervals, and if the pH tends to become too high the light should be cut off in order to inhibit further photosynthesis.

Temperature Requirements

As in the case of many other forms there is for ascidians a temperature range of about fifteen degrees centigrade within which normal development is possible. This range may be high or low, it may vary for the same species in different localities, or it may vary for the same species in summer and winter, e.g. Parechinus. (9) Thus *Eugyra pilularis* will develop at 18° C. at Woods Hole (the southern extremity of its distribution range) but not above 12° C. if taken from the colder waters of the Bay of Fundy. (2)

In general, however, it is reasonably safe to assume that normal development and growth is possible when there is little difference between sea temperature and air temperature, whatever it may be, and that the temperature of the water in which development is proceeding should never exceed by more than 5° C. the temperature of the water from which the parents were taken. This margin should be reduced where sea temperatures exceed 25° C. Culture vessels kept beneath a small tent with the walls kept saturated with water has been found to reduce the air temperature by several degrees. The distribution range of a species relative to the locality where it is taken gives some indication of its temperature tolerance. Species found near the southern end of their range are not likely to tolerate temperatures higher than that of the water in which they are found, species from the northern end of their range will tolerate temperatures considerably higher.

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ORNITHOLOGICAL NOTES WITH SPECIAL REFERENCE TO BIRDS AT WOODS HOLE

I. GULLS AND TERNS

F. N. Whitman

The seasonal changes in bird population here may interest summer folk, who have not seen the great rifts of waterfowl, or the spectacle of herring gulls feeding at their doorsteps like flocks of great pigeons. At a feeding station on a Falmouth herring run last winter, came regularly, eider ducks, mallards, sea ducks, etc.

A few black backed gulls are seen with the herring gulls. The young of the former may be told by larger size, and light color, while the young of the latter are dark. Adult herring gulls (pearl gray mantale and white below) are at least two years old. The black headed laughing gulls arrive in April and in the fall we have the small bonapart gulls (also blackheaded) which play around the Marine Biological Laboratory piers for several weeks.

Terns arrive from South America early in May and in two or three weeks start nesting. One to three and even four eggs (buff to greenish, marked with browns and lilac) are laid in depressions in the sand above high water. The male feeds the female while she does most of the incubating. Downy young are often shielded from the sun. They crawl about, swim readily, and squat flat to escape notice. A parent may coax its offspring away from danger, by walking backward, holding a fish just out of reach. They single their own out amid the swarms, feeding them shiners, sand eels, etc.

Even the night is not quiet, as some terns are going and coming. Terns do not often alight on the water except near their nesting sites.

A PHOTO-ELECTRIC METHOD FOR RECORDING FAST CHEMICAL REACTIONS AND ITS APPLICATION TO THE STUDY OF CATALYST-SUBSTRATE COMPOUNDS

DR. KURT G. STERN, *Visiting Lecturer in Physiological Chemistry, Yale University,* and MR. DELAFIELD DUBOIS, *Research Assistant, Department of Physiology, Yale University Medical School, New Haven, Connecticut*

The kinetic theory of enzyme action, as developed by Henri, Michaelis, van Slyke, and other authors, postulates the intermediary formation of an enzyme-substrate compound in the course of the reaction. The theory makes the further assumption that this intermediate is unstable. Besides dissociating reversibly into its two components, it also breaks down irreversibly to form the free enzyme and the product molecules of the reaction. However, these equations which are derived by the use of the law of mass action may likewise be arrived at by postulating a mechanism of heterogeneous catalysis and the use of Langmuir's adsorption isotherm. This ambiguity has been pointed out by Hitchcock and by other workers.

In the case of the catalytic decomposition of certain peroxides, the following mechanism can be experimentally verified:

$$E + S \rightleftharpoons ES$$
$$ES \rightarrow E + P_n ,$$

where E stands for enzyme, S for substrate, and P_n for product molecules. The formation and the decomposition of the enzyme-substrate compound, or more generally, of the catalyst-substrate compound may be observed spectroscopically in the case of the catalase-ethyl hydrogen peroxide catalysis and also in the course of the reaction of methemoglobin with hydrogen peroxide and ethyl hydrogen peroxide. Methemoglobin is of special interest here, since it has been demonstrated that it has the same prosthetic hematin group as the enzyme. The two catalysts differ only in respect to their protein carrier. It has been possible to transform the enzyme into the blood pigment by the substitution of globin for the enzymatic protein.

For the quantitative kinetic study of the optical changes accompanying the reaction cycle, a photo-electric method has been developed. The principle of the method is as follows:

Light of high intensity passes a monochromator. The monochromatic radiation, selected in such a manner as to correspond to the position of the absorption bands to be studied, penetrates a cell containing the reaction mixture and impinges on the cathode of a photo-electric cell. The photo-electric current is amplified by a one-stage radio tube amplifier. The latter is connected with a string galvanometer equipped with a moving film camera. At the beginning of the experiment the substrate is added to the solution of the catalyst, contained in the absorption cell. Rapid mixing free from appreciable mechanical, electrical, or optical disturbance is accomplished by the use of an injector mechanism specially developed for the purpose. The changes in light absorption accompanying the chemical reaction will cause deflections of the galvanometer string which are continuously recorded on the photographic film. The film is provided with a coordinate net. The abscissa permits direct reading of the time lapsed at any stage of the reaction. The unit of time is 0.025 seconds. The ordinate can be calibrated to correspond to changes in concentration of one reactant. By varying the speed of film transport, relatively slow and fast reactions may be studied. Since mixing is complete after 0.025 sec., any additional changes on the photographic record represent changes in the light absorption of the system caused by chemical reactions.

The method has been applied to a preliminary study of the catalytic decomposition of ethyl hydrogen peroxide by liver catalase and by methemoglobin. Though the results are by no means complete, the following statements can already be made: if the fading of the absorption bands of the two catalysts in the red region of the spectrum upon the addition of the substrate is taken as the measure of the rate of transformation of free into combined catalyst, this rate is contrary to that which would be expected from the catalytic efficiency of the two catalysts: whereas the over-all reaction in the case of the enzyme is much faster than in the case of methemoglobin, the combination of the latter with the substrate is considerably faster than the corresponding phase in the enzyme reaction. The half-time required for the enzymatic reaction was found to be 0.94 sec. (at pH 6.8) and that for the non-enzymatic catalysis 0.03 sec. (at pH 5.3). Both changes are rapid compared with the time required for the formation of the final reaction products, one of which is acetaldehyde. But they are slower than the combination of molecular oxygen with hemoglobin and hemocyanin. The half-times found for the latter reactions by Millikan, who used a modification of the flow method of Hartridge and Roughton, are 0.01 sec. for sheep hemoglobin and 0.008 to 0.012 sec. for Limulus hemocyanin.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 14).

EFFECTS OF SALTS ON THE INJURY POTENTIAL OF FROG MUSCLE

Dr. H. Burr Steinbach
Instructor in Zoology, University of Minnesota

If a living cell or tissue is immersed in an electrolyte containing medium, an electrical potential difference usually can be measured between the two phases. If the nature or the concentration of the electrolyte of the fluid medium is varied, the potential difference will also change. Then if for any particular salt one plots the difference of potential measured between the material and the fluid medium against the logarithms of the electrolyte concentrations of the medium, regular curves are obtained which can be described and predicted by ordinary diffusion potential equations. The only important assumption necessary is that the cell or tissue furnishes an electrolyte with a slow moving anion and a rapidly moving cation. Making this assumption it is easy to show that the shape of the p.d./log concentration curve for any given electrolyte system can be accurately calculated. With high concentrations of salt applied, the slope of the curve is determined by the nature of the salt used. With low concentrations the slope of the curve is determined by the unknown electrolyte of the biological system and is nearly independent of the nature of the salt of the environment. A model duplicating the essential features of such curves may be obtained by allowing salt solutions to diffuse against sodium or potassium gelatin gels. With such a model the potential differences can be calculated using known physical constants.

I have investigated the effects of salts and salt concentration on the injury potential of the frog sartorius muscle when the experimental solutions were applied to the uninjured surface. In this tissue it is possible to make a definite suggestion about the nature of the electrolyte within the muscle cells which might be responsible for a high diffusion potential. Frog muscle is rich in potassium ion, the sartorius containing about tenth molar potassium. It is also known that inorganic cation is in excess of inorganic anion, the difference presumably being made up by the protein content of the muscle. Of the total potassium present only about a tenth appears to be diffusible from the normal intact cell. Hence, in my calculations, using Henderson's equation, I assumed that the frog sartorius could be represented as a solution hundredth normal in potassium proteinate. The proteinate anion was assumed to be univalent with a mobility of 25 at 18°C. The mobilities of the other ions were taken from the usual physical tables.

The experiments were very simple. Frog sartorii were removed with as little injury as possible except to the pelvic end which was sectioned. The muscles were immediately placed in isotonic sucrose solution buffered at pH 7.4 for one hour. They were then removed to special paraffin chambers so constructed that the cut pelvic end dipped into tenth molar potassium chloride solution and the uninjured end dipped into the experimental salt solution. Dilute solutions were made by diluting isotonic salt solutions with isotonic sucrose solution. All solutions were buffered at pH 7.4 but the concentration of buffer was always small compared to the concentration of salt desired. Electrical leads were established with the usual saturated potassium chloride bridges.

Sodium chloride, sodium acetate and potassium chloride solutions were tested. Calculations predicted that the p.d./log NaCl concentration curve should be slightly U shaped. The curves for sodium acetate and potassium chloride should not be U shaped and the values of the injury potential with isotonic solutions bathing the uninjured surface should be considerably less than the corresponding injury potential with sodium chloride.

The shapes of the sodium chloride and the sodium acetate curves agreed well with the theoretical. In order to obtain a quantitative agreement it was necessary to add fifty millivolts to each calculated value. When this was done, good agreement was obtained throughout the concentration range 0.1 to 0.0005 molar.

With KCl, the observed values fell along the calculated curve (plus forty millivolts correction) in the range 0.005 to 0.0005 molar. KCl solutions 0.01 molar and greater were progressively more negative than the corrected calculated curve. With isotonic (0.1 molar) KCl the observed value was over forty millivolts negative to the corrected curve. Since good agreement with the corrected curves (calculated values plus forty or fifty millivolts) was obtained with sodium chloride, sodium acetate and the more dilute solutions of potassium chloride, it seems probable that the correction represents the major part of the normal injury potential. This large part of the measured injury potential is not affected by the presence or concentration of sodium chloride, sodium acetate or the more dilute potassium chloride solutions. On the other hand, potassium, in higher concentration, must have one of two effects upon this injury potential. Either it must penetrate into the uninjured surface and destroy a mechanism existing there which gives rise to the normal injury potential, or it must act upon the uninjured surface in such a manner as to cause injury and set up a counter potential difference which nullifies the one existing at the injured end of the muscle.

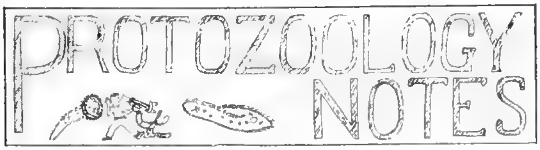
The experiments do not differentiate between these two possibilities although the latter seems most probable.

These studies show that so far as the electrical evidence is concerned, all ions, with the possible exception of potassium, appear to penetrate the cell surface at rates which are not modified, in any differential sense, from their rates of free diffusion in water. In other words, while there is a possibility that the muscle surface is specifically permeable to potassium ions, there is no evidence of a general permeability to cations in distinction to anions.

It is interesting to note that the concentration of potassium at which the specific effects of this ion are evident is a rather important concentration in muscle physiology. At about this point a slight contracture sets in, oxygen consumption increases and various chemical changes take place. It is probable that this break in the concentration potential curve denotes some drastic change in the constituents of the cell, presumably the formation of excess potassium proteinate at the point effected.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 14).

NOTES AND NEWS FROM M. B. L. CLASSES



Dr. Calkins of the Protozoology course has invited his entire class for tea on Sunday afternoon.

Dr. and Mrs. Frank R. Lillie entertained a group from the Marine Biological Laboratory at a tea at their home on Sunday, July 12. Among the guests were: Mr. and Mrs. Steve Bosckey, Miss Betty Andersch, Dr. Marie Andersch, Mr. Paul Dugal, Mr. Daniel Lilly, Rev. Michael Fronzak, John P. O'Brien, James Donnellon, O. S. A., Miss Kathleen Kennedy, Miss Elizabeth Thornton, Miss Alice Russel, and Mr. and Mrs. Theodore Von Brand.

—*E. T.*

If there be a "critical" time in the life of the embryology class at Woods Hole, it is the next-to-the-last week. The professors had become aware for the first time of a lag of interest which has disappeared again during the final week. Acute writers' cramp and chronic absence from the laboratory are the symptoms displayed by those who are planning the coming weeks of mountain climbing, sailing, or collecting Canadian salmon parasites.

During the past week live annelids and mollusks were provided, for the study of their young. Methods for inducing spawning and the procuring of eggs were demonstrated, and the eggs were followed through their development from cleavage until metamorphosis from trochophores into the more complicated veliger or the adult form. Specimens included *Hydroides hexagonus, Nereis limbata, Chiton squamosus, Teredo thompsoni,* and *Cumingia tellinoides.* Mabel Culberson (student) discovered in an adult Cumingia, the miracidia of a hitherto undescribed trematode. After verifying her preliminary observations, Dr. Stunkard accepted this as one more subject for his extensive life-history studies.

The scheduled lecturers of the week were Dr. Packard, Dr. Grave, and Dr. E. R. Clark. After preliminary work covering a period of ten years Dr. Clark reported on "Observations on Embryological Processes Occurring in Adult Animals," as observed with the permanent study chambers which he has succeeded in placing in the ears of rabbits. He concluded his lecture on Friday with an invitation to the class for a visit to his Woods Hole laboratory in which he and his wife are continuing the investigation this summer. The unanimous acceptance of the invitation is sufficient indication of the real interest (even during the "critical week") of the class in a fascinating study.

The *Nereis* sailed out to the Hole on Saturday morning with a boatload of embryologists to demonstrate the collecting net method as applied to marine larvae. The harmonious vocal exercise, which is generally expected to accompany the return voyage of this embryology class from any boat trip, was lacking. Dampened by the gentle rain? Prevented by the presence of so many larvae of the arthropods and mollusks, and the total absence of young echinoderms (as later revealed by class investigation of the catch)?

This review is incomplete, of course, if no mention be made of the hitherto publicized recreational activities of the students. Monday night

the embryologists lost (4 to 5) their championship of the M. B. L. League to the collecting crew (who are not to be bluffed by Prairie Softball Rules.) Following the defeat, one despondent student dwelt upon the towing trip of the coming Saturday, and realized that there could be no beach party. The realization spread abroad. In fact, it was carried bodily to Provincetown, and Boston, by certain members of the class. It inspired a pilgrimage to Plymouth. It was "new business" at a meeting of the Shykin Camera Club and the Et Al Photo Finishing Society. A few embryo-photographers angled for a view of the night boat on its trip through the canal. There was a game of hearts. Saturday afternoon, there was talk of a bridge game. Sunday, there was peace in the laboratory.

—*Donald Bauer*

BOTANY CLASS NOTES

On Monday, July 20, Dr. and Mrs. Taylor invited the Botany class to a delightful buffet supper. After supper, Dr. Taylor showed up our intellectual abilities with several interesting games. All too soon the evening was over.

On Tuesday we planned a beach party, the weather had a few plans of its own, which unfortunately did not agree with ours; the beach party has been indefinitely postponed.

The field trip to Gay Head loomed in a decidedly menacing manner. We had been promised seasickness and all its attendant horrors. Wednesday dawned bright and clear, the sea was calm, and our last field trip was a grand success. Gay Head is indeed a lovely sight, and the swimming (also the collecting) is fine. We came home in a gay mood, quite reconciled to our last three days of extra hard work —*M. T.*

PHYSIOLOGY CLASS NOTES

On Wednesday Dr. Hartline demonstrated for the physiology class and its guests his method for obtaining action potentials from a single fiber of the optic nerve of Limulus. It was an unusual opportunity for most of us to accurately see and hear an optic nerve in action. The electrical apparatus used for amplification of the action potentials was hooked up so that the action potentials could be heard by means of a loud speaker and seen by means of an oscillograph. After listening to a single fiber fire off in response to various intensities and color of lights it was quite impressive to see the size of the fiber under the dissecting microscope and one could not but be impressed with the exactness of technique that is necessary for the isolation of such a minute fiber.

The inquiring reporter this week went on the trail of three of the class instructors, two of whom are Canadians, Dr. Kenneth Fisher and Dr. F. J. Sichel, and a former Canadian, Dr. Robert Chambers. Dr. Chambers was found working at the 1936 model of his micro-dissection apparatus, which is quite an impressive affair, so he was too engrossed to tell us how he likes his eggs done or who is his candidate in the election. The following items were therefore gleaned from "Who's Who." Dr. Chambers was born in Turkey of Canadian parents, and did his graduate work in Canada, Germany, and the United States. He is distinguished in the field of cytology and micromanipulation. For his work on the physical nature of protoplasm, he was the recipient of two medals in 1925, one from the city of Philadelphia, the other from the Linnean Society of London. During the year Dr. Chambers works in New York City where he is research professor of biology at Washington Square College of New York University.

Dr. Sichel, who with Dr. Chambers is supervising the work on micromanipulation, did his undergraduate work at McGill University and much of his graduate work at New York University. He later taught at both institutions as well as at the University of Pennsylvania. Last year he held a fellowship from the Royal Society of Canada and worked at the Johnson Foundation of Biophysics at Pennsylvania. Most of his work has been on the physiology of the isolated muscle fiber. Dr. Sichel is the retiring secretary of the M. B. L. Club on which he assures us he spends his leisure time. In the winter when the Club is not on his mind he skates and skis.

Dr. Fisher, usually known as "Ken" has been in charge of that part of the course called the "Fundulus heart" in which studies are made of systems involved in maintaining the rhythm of the heart beat. During the winter he is demonstrator in experimental biology at the University of Toronto. He did not make it clear as to what it is that he demonstrates, but hearts are his particular interest. That, along with his excellent tennis, seems a very desirable combination.

This week the laboratory has become a hot bed of research, studies of many kinds have been started and each person is tending his own problem with fervor and devotion, hoping, but not expecting, that some little sprout may appear in these two weeks. It may be of interest to know what some of these problems are.

Mrs. Wood and Miss MacDonald are trying to tease some of the dehydrogenase out of frog liver and muscle and beef muscle. They think that the laboratory should provide as part of the equipment a complete set of German, French, Scandanavian, Russian, and Hungarian translators.

Our impressario, M. Paul Dugal, is using various treatments to try to soften the hyaline plasma membrane of arbacia eggs and trying to see if the membrane has any influence on gastrulation.

Under the direction of Dr. Prosser, Chambers (A. H. Jr.) is making strength duration curves

(Continued on page 106)

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

AWARD OF THE NET SCHOLARSHIPS

Circumstances have made it necessary to address the following letter to the directors of the five courses in the biological sciences at the Marine Biological Laboratory:

It has become so much the custom for THE COLLECTING NET to provide a hundred dollar scholarship for a student in the .... course to return to the laboratory for work the following summer that it is perhaps desirable that we write to let you know that it seems most unlikely that money can be made available for this purpose during the present season. We have sought advice from many sources and it seems to be the consensus of opinion that the scholarship should be available only to students or young investigators who are registered at one of the laboratories who are cooperating in the work of THE COLLECTING NET Scholarship Fund Association.

It was with some surprise and chagrin that we learned that the Marine Biological Laboratory could not at the present time see its way clear to appoint an individual on the Board of Trustees of the Scholarship Fund Association. We sincerely hope that next year the whole matter will come up for reconsideration and that money for the award of a scholarship can again be turned over to the staff of the .... course.

It is our intention to divide the available scholarships this summer among the institutions who have appointed an official representative on the Board of Trustees of THE COLLECTING NET Scholarship Fund Association.

The letters referred to in this column last week were not mailed until Tuesday and most of the laboratories have not had time to state their policy in connection with the possibility of granting free research space to holders of COLLECTING NET Scholarships. An answer to one, the Biological Laboratory at Cold Spring Harbor, has come, however, and we take pleasure in reproducing it in an adjacent column.

THE BIOLOGIST AND HIS TOOLS

THE COLLECTING NET will be under obligation to students and teachers of the biological sciences if they will give careful consideration to the products sold by these firms before purchasing from other establishments. This is a natural request and a natural thing for a reader of the magazine to do, because the number of pages and the number of illustrations that we can print is in direct proportion to the support given to it by manufacturers of scientific apparatus, supplies and books. In turn, the amount of advertising space that we can sell depends upon the support given to these firms by the readers of THE COLLECTING NET. We shall consider it a gracious gesture if biologists will consult our advertising pages for the tools that they need in their work; and further, mention THE COLLECTING NET when it has been a factor in helping them reach a decision concerning these tools.

The publication of THE COLLECTING NET is made possible by the firms listed here.

Scientific Apparatus and Supplies:

American Instrument Company, Inc., American Type Culture Collection, Barnstead Still & Sterilizer Co., Bausch & Lomb Optical Company, Calibron Products Inc., Clay-Aadms Company, Eimer & Amend, Fish-Schurman Corporation, General Biological Supply House, Hoke, Inc., Howe & French, International Equipment Company, E. Leitz, Inc., E. Machlet & Son, New York Scientific Supply Co., Pfaltz and Bauer, Inc., Purina Mill, Spencer Lens Company, Voland & Sons, Inc., Will Corporation, Carl Zeiss, Inc.

Scientific Books:

P. Blakiston's Son & Co., Henry Holt & Co., Lea & Febiger, Macmillan Company, Oxford University Press, Stanford University Press, G. E. Stechert & Co., The University of Chicago Press, The University of Michigan Press, John Wiley & Sons, Inc., Williams & Wilkins Company, The Wistar Institute.

Only through its journal has THE COLLECTING NET Scholarship Fund been made possible. Over four thousand dollars have been awarded to promising young investigators because of its publication; its very existence is dependent upon the firms whose names are given above. If they banded together and agreed not to announce their products in THE COLLECTING NET next summer the journal and its Scholarship Fund would cease to exist.

We have interesting plans for increasing the size and usefulness of THE COLLECTING NET which are impeded by a limited budget; we appeal to its readers to acquaint themselves with the products of our advertisers. An editorial appeal of this kind is not customary, but this journal is not bound by custom.

The existence of the journal is brought about by the triumvirate: advertiser—reader—editor; weaken one member and the rest are weakened; strengthen one and each benefits. Purchase! Subscribe! Contribute!

From the Biological Laboratory, Cold Spring Harbor

July 23, 1936

Dear Dr. Cattell:

Thank you for your letter of July 22nd. I am glad that the plans for The Collecting Net Scholarship Fund are going all right.

We shall certainly be very glad to give free research space to people holding a scholarship, and to help them with their research in any way within our power.

(Signed) ERIC PONDER

ITEMS OF INTEREST

Dr. David H. Tennent, Professor of Zoology at Bryn Mawyr College, is in the Tortugas. Mr. David Tennent who just graduated from Yale is working with his father.

Dr. Walter E. Garrey, professor of physiology at Vanderbilt University Medical School is recovering from a recent operation; he is still confined to his house on Gardner Road.

Dr. and Mrs. Ralph Wichterman and baby son arrived at Woods Hole for the summer. Dr. Wichterman who teaches at Temple University received his doctorate at the University of Pennsylvania this past year.

Dr. Harold H. Plough, professor of biology at Amherst College, is at the Tortugas Laboratory where he is spending the summer working on tunicates. Mrs. Plough will come to the Plough cottage in Woods Hole early in August.

Dr. Lionel A. Walford, instructor in zoology at California State College, has just completed work on his book, "Marine Game Fishes of the Pacific Coast from Alaska to the Equator," which will be published in November. It is illustrated with paintings by Rink Mamlinquist and photographs in natural color by Ralph Emerson.

Dr. Katsuma Dan of the Laboratory had three visitors from Tokio this week. Dr. M. Kawai, Tokio cod liver oil manufacturer who has been inspecting methods of production in Norway, Dr. S. Miyazaki of the department of pharmocology, Keio University, and Mr. S. Terai.

Dr. and Mrs. H. B. Steinbach arrived at Woods Hole after a two week's motor trip from Minnesota where Dr. Steinbach is a member of the University of Minnesota staff.

Dr. and Mrs. Metz have rented their two cottages on Hyatt Street and have taken a farm at West Moarland, New Hampshire, for the summer.

Miss Betty Andersch of Rock Island, Illinois, who has been visiting her sister, Dr. Marie Andersch of the physiology class since June, left last week for Iowa State University, Iowa City. Miss Andersch plans to complete her work for her masters degree in speech and dramatics at the summer session of Iowa State University.

Miss Martha Reed, recently elected president of the undergraduate student body of Barnard College, was the guest of Dr. Opal M. Wolfe, assistant professor of zoology at Barnard, at Woods Hole last Tuesday. Miss Reed, who is a zoology major, is spending the summer at Edgartown on Martha's Vineyard.

THE BASS BIOLOGICAL LABORATORY

The Bass Biological Laboratory at Englewood, Florida, offers fellowships to members of staffs of different institutions who have definite, outlined problems which fit in with the equipment and natural fauna and flora of the laboratory. It is located on salt water, but there are many fresh and brackish water ponds and streams in the neighborhood. The surrounding countryside is sparsely settled so that the natural fauna and flora have not been molested. Collection activities are carried on by car, truck, row boats, motor boats, and a two masted schooner with auxiliary motor.

The fellowships entitle the accepted applicant to laboratory space, living quarters, and meals, free of charge. In cases where the collection problems entail extra expense and attention a nominal charge is made. We have had cases where research workers desired to bring their families with them. It is possible for us to rent cottages in the neighborhood of the laboratory for twenty-five or thirty dollars a month. Such fellowships are entitled only to laboratory space and collection service.

Previously our laboratory has been closed during the summer because we felt that there were adequate facilities at Dry Tortougas. During the last winter we have established a small supply department which necessitates our keeping this laboratory open the year round. It will now be possible for us to grant fellowships during any season of the year. The duration of such grants is wholly dependent upon the research problems involved.

Should any of the faculty of institutions be interested we would gladly receive application or forward specific information regarding our location and its adaptability to the problem involved.

M. B. L. Club Notes

At a meeting of the M. B. L. Club last Monday, Dr. Charles Packard was elected president, Dr. Laurence, vice president, and Dr. William W. Ballard, secretary-treasurer.

The regular Monday concert was interrupted during the first part of the program when the amplifying system refused to function. After working on the machine Dr. S. E. Hill played the rest of the program for the fortunate few who happened to be there. The full program was presented on Wednesday night.

The second Mixer of the season will be held by the M. B. L. Club on Saturday, August 1. Mrs. Heinz Specht has been elected social chairman.

Introducing

DR. JOHANNES HOLTFRETER, Rockefeller Foundation fellow and assistant professor at the Munich Zoological Institute. Dr. Holtfreter was born in Richtenberg, Germany. He attended the University of Rostock, Leipzig, and the University of Freiburg in Baden, receiving his Ph.D. from the latter in 1925. At the University of Freiburg he worked under Dr. Hans Spemann on the determination of liver and pancreas in the development of triton.

Dr. Holtfreter traveled extensively in Europe and spent nine months at the Naples biological station as a research worker. In 1927 he went to Berlin to become assistant in experimental embryology to Dr. Otto Mangold at the Kaiser Wilhelm Institute. After six years he went to Munich Zoological Institute of which Dr. Karl von Frisch is director to become assistant professor.

Just before coming to America he traveled in Belgium, the Netherlands, and Spain, lecturing at Santander, Spain. As a Rockefeller fellow he has worked since September at Yale University on experimental embryology and at the Carnegie Institute at Baltimore on the development of the chick. At the Marine Biological Laboratory he is working with fish eggs.

In August Dr. Holtfreter will go West to California and from there will take a six months' trip through Japan, Indo-China, and the Dutch Indies, lecturing and visiting universities. He will return to his post in Munich in February.

Dr. Holtfreter's publications include some twenty-eight papers in experimental embryology.

E. T.

PHYSIOLOGY CLASS NOTES

(Continued from page 103)

by stimulation of the giant fibers of the squid, and Huldah Magalhaes is making some carefully designed shellacked strips of paper to be used later as wall paper we understand. The designs are being executed by the clam heart with and without acetyl choline.

Robert Ballentine is diligent (as usual) in his efforts to find out what effects thyroxin has on the oxygen uptake of pecten muscle under various conditions of pH and oxygen tension. He is rapidly increasing his vocabulary.

Lena Lewis and Judith Smith are work on Dr. Ferguson's pet: carbonic anhydrase. They are working out various quantitative methods of extracting the enzyme from different invertebrate tissue, and studying how certain procedures such as the use of preservatives effect the enzyme.

—*Elizabeth Magers and (Mrs.) Alburtha Wood*

PROGRAM OF THE GENETICS SOCIETY OF AMERICA

Meeting at the Marine Biological Laboratory on the First Friday and Saturday in September

Thursday, 8:00 P. M. M. B. L. evening lecture by Professor Th. Dobzhansky, California Institute of Technology, Pasadena, Cal. "Genetic nature of specific and racial differences."

Friday, 9:30 A. M. Round table conference: "The nature of mutations." Leader, Prof. R. A. Emerson, Cornell University, Ithaca, N. Y., Introducers, Dr. R. A. Fisher, Galton Laboratory, London, England, and Dr. L. J. Stadler, Bureau of Plant Industry at the University of Missouri, Columbia, Mo.

2:00 P. M. Demonstration papers.

6:00 P. M. Clam Bake.

Saturday, 9:30 A. M. Round table conference: "Progress in cytogenetics." Leader, Karl Sax, Harvard University, Cambridge, Massachusetts, Introducers, Prof. C. L. Huskins, McGill University, Montreal, Canada, and Dr. C. B. Bridges, Carnegie Institution of Washington at the California Institute of Technology, Pasadena, California.

CURRENTS IN THE HOLE

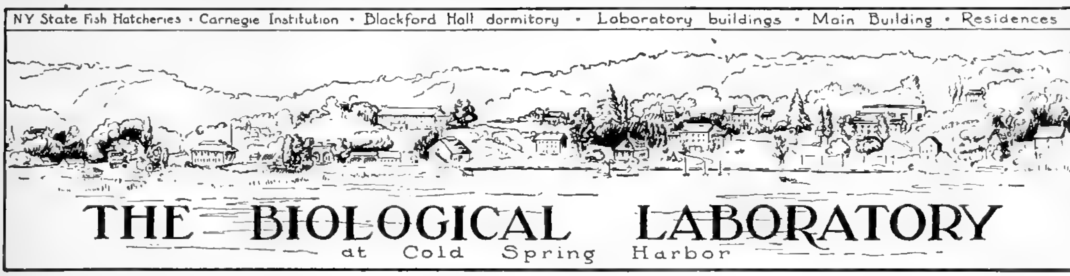
At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 27	11:24	....
July 28	12:03	12:15
July 29	12:59	1:06
July 30	1:53	1:57
July 31	2:43	2:51
August 1	3:32	3:41
August 2	4:14	4:27
August 3	4:58	5:10
August 4	5:44	5:57
August 5	6:28	6:49
August 6	7:15	7:36
August 7	8:02	8:28
August 8	8:49	9:22

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

BIOLOGICAL SONGS

THE COLLECTING NET is planning to publish "M. B. L. Songs." It would like to have these phamphlets include a representative collection of the favorite songs of the laboratory people. If any readers of the journal know any songs, biological or otherwise, which they consider appropriate to such a collection (that do not appear in the well known anthologies) we shall appreciate it if our readers will send the names of the songs, the words, and the melodies to us for possible inclusion in these two booklets.



BRIEF ABSTRACTS OF SOME SYMPOSIUM PAPERS

DR. HARRY GRUNDFEST: "Effect of Hydrostatic Pressure upon the Excitability, the Potential Sequence, and the Recovery of Frog Nerve."

Hydrostatic pressure produces changes in the processes involved in the excitation, the electrical activity, and the recovery of frog nerve. At low pressures (below 5000 lbs.) there is a lowering of threshold, an increase in spike height and duration, an increase in the negative after potential and in the amount of positivity, a slowing of the disappearance of local excitatory state, and a slowing in the curve of recovery. Above 5000 lbs. there occurs a new phenomenon, the ability of some fibers to respond repetitiously to a single brief shock. Prolonged application of higher pressures (above 8000 lbs.) produces an inexcitable state. On release from medium pressures excitability goes through a subnormal minimum, and the duration of the negative after potential is prolonged. The effects of pressure are reversible. From the behavior (under pressure) of the different manifestations of nerve activity, there are indications that this method of study permits a separation of the various component processes of activity.

DR. FRANCIS O. SCHMITT: "The Oxygen Consumption of Stimulated Nerve."

A description was given of the microtechnique by which it has been possible to measure the oxygen consumption of single frog sciatics or bull frog spinal roots whilst at the same time recording the action potential oscillographically. At low frequency of stimulation the increase in metabolism is less than would be expected by extrapolation of the curve at high frequencies; it may be zero. Veratrinized nerves consume much more oxygen when stimulated at low frequencies than unpoisoned nerves under similar conditions. Yohimbinized nerves stimulated at the same frequencies appear to respire at less than resting rate. From this it would seem that the effect on respiration which results from stimulation of an unpoisoned nerve depends upon the balance between the tendency for the spike to be associated with a negative or a positive after potential.

DR. MCKEEN CATTELL: "On the Significance of Initial Heat and its Application to the Measurements of Muscular Efficiency."

Evidence has been summarized which makes it clear that the tension developed in a muscle twitch does not bear a constant relationship to the total energy mobilized. The older work has established the fact that the ratio of tension to heat is a fairly constant one under normal conditions, but we now know of many conditions which significantly alter this relationship. The current theories of the underlying chemical mechanisms associated with muscular contraction give ample latitude for the explanation of the large changes in the efficiency of the process. However, at the present time attempts to relate the chemical reactions to specific physical events, such as heat and tension, are fraught with uncertainty. Until this can be done the interpretation of the variations in the efficiency of muscular contraction in terms of the chemical changes involved must remain a matter for conjecture.

(Received July 14, 1936)

Visitors at the Laboratory during the past week include Dr. and Mrs. McKeen Cattell, Dr. and Mrs. Hallowell Davis, Dr. and Mrs. W. O. Fenn, Dr. Ernst Fischer, Dr. Herbert Gasser, Dr. R. W. Gerard, Dr. and Mrs. Frank Blair Hanson, Dr. and Mrs. Hudson Hoagland, Dr. and Mrs. Oscar Wyss.

Members of the courses in Surgical Methods and General Physiology have organized a series of informal evening colloquia, and members of the staff and other investigators have agreed to talk to them on certain phases of fundamental physiology. One of the purposes is to give the students an opportunity to discuss with the speakers research problems which have not as yet been attacked.

Mrs. F. O. Schmitt and Dr. Arturo Rosenblueth gave an informal concert at Blackford Hall.

The baseball games have begun. After a series of practice matches, the "surgeons" defeated the "physiologists," 19 to 10.

Dr. R. W. Gerard will lecture on Tuesday evening, July 14th, on "Brain Waves."

DEPARTMENT OF PUBLICATIONS

FORTHCOMING ARTICLES IN "THE AMERICAN JOURNAL OF PHYSIOLOGY"

Olmsted, J. M. D., Margutti, M., Yanagisawa, K., Adaptation to Transposition of Eye Muscles.

Brogden, W. J., Girden, Edward, Mettler, Fred A. and Culler, Elmer, Acoustic Value of the Several Components of the Auditory System in Cats.

Kriss, M., Influence of the Plane of Nutrition on the Manner of Heat Disposal by Cattle.

Buell, Mary V., Anderson, Ian A. and Strauss, Margaret B., On Carbohydrate Metabolism in Adrenalectomized Animals.

du Buy, H. G. and Coppée, G., The Electric Phenomena of the Crayfish Claw During Repetitive Stimulation.

Van Liere, E. J., Effect of Prolonged Anoxemina on the Heart and Spleen in the Mammal.

Wilson, Helene C., The Relation between Rhythmic Variations in Blood Pressure and Rhythmic Contractions of the Artery of the Ear of Rabbits and Dogs.

Katz, L. N., Gutman, I. and Ocko, F. H., Alterations in the Electrical Field Produced by Changes in the Contacts of the Heart with the Body.

Forbes, W. H., Blood Sugar and Glucose Tolerance at High Altitudes.

Shapiro, A. and Koster, H., The Influence of Bile on the Excretion of Sterol in the Feces.

Mirsky, I. Arthur, The Site and Mechanism of the Antiketogenic Action of Insulin.

Gellhorn, E. and Janus, A., The Influence of Partial Pressure of O_2 on Body Temperature.

Necheles, H., Levitsky, P., Kohn, R., Maskin, M. and Frank, R., The Vasomotor Effect of Acetylcholine on the Stomach of the Dog.

Apperly, Frank L. and Cary, M. K., The Chloride and Alkali Content of the Duodenal Secretions and Their Relation to Gastric Acidity and Emptying Time.

Katz, L. N., Sigman, E., Gutman, I. and Ocko, F. H., The Effect of Good Electrical Conductors Introduced Near the Heart on the Electrocardiogram.

Farr, Lee E. and Smadel, Joseph E., The Urea Clearance of Rats.

Gilson, A. S., Jr., The Effects Upon the Heart Rhythm of Premature Stimuli Applied to the Pacemaker and to the Atrium.

Edwards, H. T., Lactic Acid in Rest and Work at High Altitude.

Jacobs, Henry R. and Mason, Elwood W., The Innocuousness of Histamine to the Dog.

Hillenbrand, Charles J. and Boyd, T. E., Reflex Respiratory Effects from Intermittent Stimulation of the Vagus and Superior Laryngeal Nerves.

Rosenblueth, A., Davis, H., and Rempel, B., The Physiological Significance of the Electric Responses of Smooth Muscle.

Cannon, W. B. and Rosenblueth, A., The Sensitization of a Sympathetic Ganglion by Preganglionic Denervation.

Rosenblueth, A. and Cannon, W. B., with the assistance of Rempel, B., The Adequacy of the Chemical Theory of Smooth Muscle Excitation.

Swingle, W. W., Parkins, W. M. and Taylor, A. R., Experiments on Intact and Adrenalectomized Dogs Subjected to Sodium and Chloride Depletion by Intraperitoneal Injections of Glucose.

Swingle, W. W., Parkins, W. M., Taylor, A. R. and Hays, H. W., Relation of Serum Sodium and Chloride Levels to Alterations of Body Water in Intact and Adrenalectomized Dog.

Svirbely, Joseph L., The Effect of Diets and Various Substances on the Vitamin C Content of Some Organs of the Rat.

Greaves, J. D. and Schmidt, C. L. A., Studies on the Vitamin A Requirements of the Rat.

Boothby, Walter M., Berkson, Joseph and Dunn, Halbert L., Studies of the Energy of Metabolism of Normal Individuals.

Berkson, J. and Boothby, W. M., Studies of Energy of Metabolism of Normal Individuals.

THE TERRY LECTURES OF JOSEPH NEEDHAM

ORDER AND LIFE, Joseph Needham. Lectures at Yale University on the D. H. Terry Foundation. 175 pp. 1936. Yale University Press. $2.50.

Although the announced purpose of the Terry Foundation is "the building of the truths of science and philosophy into the structure of a broadened and purified religion," rather than the exposition of scientific progress as such, Dr. Needham has made his own Terry lectures almost purely scientific, and has given a general survey of the central biological problem of morphogenesis, considered chiefly in the light of recent advances in experimental biology and biochemistry. The philosophical and religious reference is implied rather than stated. In his introduction and first lecture "The Nature of Biological Order" he explains briefly his reasons for this. While recognizing the limitations of a purely scientific approach to any problem having to do with characteristics that are essentially unique and individual —as *e.g.* why the universe has the nature it does have and not some other nature (p. 12)—he believes that too much insistence on the ultimate unanalyzability of vital processes is unfortunate for biology since it tends to discourage an experimental approach and a rigidly scientific analysis. Accordingly he makes a strong plea for a purely naturalistic treatment of the problem of vital organization. I feel, however, that a certain injustice is done to Haldane, and especially to Driesch, in some of his references to vitalism. Driesch, besides being a profound student of scientific method, has always been a convinced exponent of experimentalism in biology. Both Driesch and, so far as I can see, Needham take the same position, essentially, as does Kant in his "Prolegomena" (Carus Edition, p. 123): "Natural science will never reveal to us the internal constitution of things which, though not appearance, yet can serve as the ultimate ground of ex-

plaining appearance. Nor does science require this for its physical explanations. Nay, even if such grounds should be offered from other sources (for instance, the influence of immaterial things), they must be rejected and not used in the progress of its explanations. For these explanations must be grounded only upon that which as an object of sense can belong to experience and be brought into connection with our actual perceptions and empirical laws." Kant appears here as the radical empiricist and exponent of "physicalism" in natural science—considered purely as science.

The last two lectures are almost purely descriptive and scientific. Needham recognizes the autonomy of biological science (while taking a fling at J. Gray ; biological experimentation is prior to physico-chemical analysis (p. 22), although such analysis is the ultimate aim of physiology, which in its character as objective science proceeds on the assumption that the same types of order pervade both the living and the non-living worlds. Biological order, although on a different level from physical order, presupposes the latter as its necessary foundation. Hence radical physiological analysis converges to physico-chemical types of explanation.

In the second lecture "The Deployment of Biological Order" the organizer influence in morphogenesis receives detailed discussion and a historical review is given. The possible relations between the chemistry of compounds having organizer action and the chemistry of sterols and their related or derived hormones are indicated in a highly interesting and suggestive manner. Consideration of the physical and biochemical aspects of the problem of organization is continued in the concluding lecture, "The Hierarchical Continuity of Biological Order." The various different levels—the higher levels presupposing and based on the lower—of scientifically definable order discernible in the living organism are pointed out; such a "spatial hierarchy" is seen *e.g.* in the sequence: gross anatomy, histology, cytology, colloidal structure, biochemistry, atomic physics; analogous temporal hierarchies (division hierarchies, genetic hierarchies) are recognized, in correspondence with the varying time-spans required for the existence and activity of the spatial components. The nature of the relations existing between the living protoplasmic structure and the enzymatic and other metabolic reactions occurring within it is considered in some detail. Protoplasmic structure, although hierarchically on a relatively high level, is regarded as having close affinities with microcrystalline structure. Great importance is attached to the results of X-ray analysis; in general, emphasis is placed on the genetic continuity of morphology with biochemistry. The author holds that the steriochemical structure of the biochemical compounds determines ultimately the type of structure developed in the organism; this structure has a specific character referable in the last analysis to the chemical specificity of these compounds, especially proteins. Examples are given showing the many striking correspondences between microstructure, as illustrated in liquid crystals and the related paracrystalline ("nematic") state, and certain types of organized structure. The morphogenetic polarity shown in limb buds and in egg cells has as its probable foundation the special nematic character and polarized arrangement of the structural compounds. The stability of organization shown by the egg cell, *e.g.* in resisting disruption by centrifuging, is thus explained. The author's general conclusion is that the observed types of biological order do not require reference to specifically vital or immaterial factors but are a natural consequence of the properties of matter (pp. 164-5).

There is no space here to refer to the many interesting details of treatment and the wide range of facts and principles cited. Much of the discussion seems too technical for the non-scientific reader of the Terry lectures, but it is of none the less interest to the biologist on that account.

—Ralph S. Lillie

The Williams and Wilkins Company, publishers of scientific books and periodicals, have concluded an arrangement with the F. S. Crofts Company, college textbook publishers of New York City, for cooperative publication of basic science texts for college use.

According to Mr. Samuel Cahoon the fishing this week is quite poor. Marine Biological Laboratory fishermen may be interested to know that butter fish, scup, bass, sword, mackerel, cod, flukes, and flounders are running now.

SUPPLEMENTARY BOOK LIST

Bews, J. W., "Human Ecology" (1936) Oxford Press.

Borradaile, L. A. and Potts, F. A., "The Invertebrata" (April 1936) Macmillan.

Chandler, Asa C., "Introduction to Human Parasitology" 5th ed. (1936) Wiley.

Darlington, C. D., "Recent Advances in Cytology" 2nd ed. (1936) Blakiston.

Graubard, Mark, "Biology and Human Behavior" (1936) Tomorrow.

Raunkiaer, C., "The Life Forms of Plants and Statistical Plant Geography" (1936) Oxford Press.

Walton, E. P., and Foss, Philip E., "Social Biology" (1936) Blakiston.

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AUGER, DANIEL. Comparaison entre la Rythmicite des Courants d'Action Cellulaires chez les Vegetaux et chez les Animaux. pp. 101. $1.40. Paris, 1936.

CUENOT, L. L'Espece. (Encyclopedie Scientifique). pp. vi-310. $2.10. Paris, 1936.

DACQUE, EDGAR. Versteinertes Leben. ill. pp. 131. $2.00. Berlin, 1936.

DACQUE, EDGAR. Aus der Urgeschichte der Erde und des Lebens. Tatsachen und Gedanken. 46 ill. 230 pp. $1.78. Muenchen, 1936.

FORTSCHRITTE DER BOTANIK. Unter Zusammenarbeit mit mehreren Fachgenossen hrsg. von Fritz von Wettstein. Bd. 5. Berichtueber das Jahr 1935. 39 ill. vi-346 pp. $10.66. Berlin, 1936.

LISON, L. Histochimie Animale. Methodes et problemes. pp. vi-320. $3.50. Paris, 1936.

MONTEIL, G. L'oeuf. Essai de theorie de sa segmentation. Avec table des planches. pp. 67. $1.25. Paris, 1935.

PLOTNIKOW, JOHANNES. Allgemeine Photochemie. Ein Hand- u. Lehrbuch f. Studium u. Forschung fuer Mediziner, Biologen, Agrikulturchemiker, Botaniker etc. ill. 2nd edition. pp. viii-909. $11.10. Berlin, 1936.

PETERS, GERHARD. Chemie und Toxikologie der Schaedlings-bekaempfung. 22 ill. pp. 120. $3.40. Stuttgart, Enke, 1936.

ROCHE, J. Essai sur la biochimie generale et comparee des pigments respiratoires. pp. 170. $2.80.

SCHERSTEN, BERTIL. Studien ueber das Vorkommen und die biologische Bedeutung des Citrats in Geschlechtsdruesensekreten des Menschen und verschiedener Tiere. Nebst einem Beitrag zur enzymatisch-chem. Methode zur Bestimmung von Citrat nach Thunberg. $2.08. Lund, 1936.

SOUEGES, RENE. Exposes d'Embryologie et de Morphologie Vegetables. V: La Segmentation. pp. 80. $1.12. Paris, 1936.

VITAMINE UND HORMONE UND IHRE TECHNISCHE DARSTELLUNG, T. 1. Ergebnisse d. Vitamin- u. Hormonforschg. Von Dr. Hellmut Bredereck, Doz. pp. xi-101. $2.22. Leipzig, 1936.

Wissenschaftliche Ergebnisse der deutschen atlantischen Expedition auf dem Forschungs- und Vermessungsschiff "Meteor", 1925-1927. von Albert Defant. Bd. 6, T. 1. ill. Subscr. price complete, bound, $34.78. Berlin, 1936.

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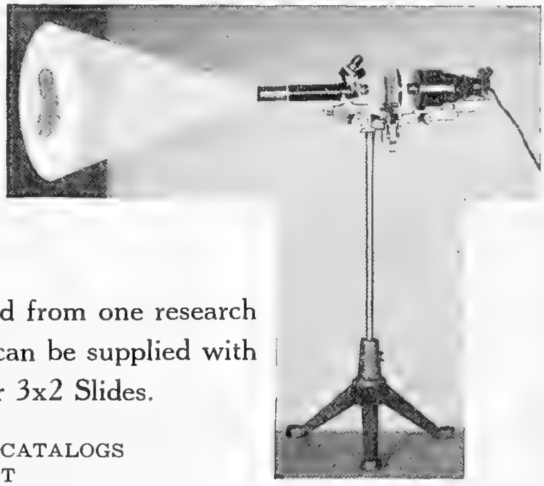

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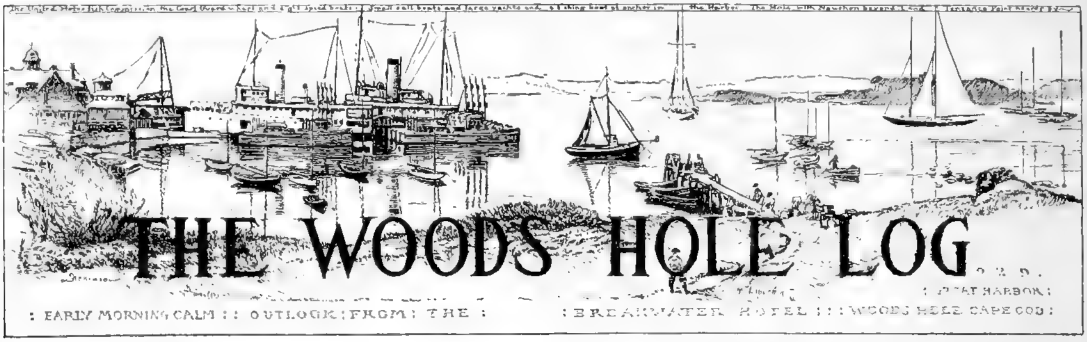

INDOLENCE?

Why do the natives of Woods Hole possess a seemingly innate desire to stick by the old adage, "Hooray for me—to h--- with you?" True, those who abide faithfully to this old maxim never find themselves in trouble but human nature demands a more broadminded viewpoint. Speaking in general, there is—and always has been—a very apparent lack of interest in anything that goes on in Woods Hole—be it a baseball game or an effort on the part of those few, very few, individuals who are interested enough to want to improve our promising community.

To cite a few examples: Last fall a group of citizens formed the Woods Hole Improvement Association in an effort to improve and beautify the town. Meetings were held and all those who were in any way interested were invited to attend. No more than a handfull of people ever came to these meetings. When a member of the committee asked for donations with which to carry on the work the response was so poor that the organization has done nothing.

Three years ago a group of young men, all residents of Woods Hole, decided to form a baseball team. At a meeting held by this group it was decided that the only way that they could raise the funds necessary for such an undertaking was to solicit money. It was also decided that they would ask only those who could afford to donate—namely, the merchants and summer residents. The summer residents gave generously, but the majority of the merchants gave little or nothing at all.

Why must the lack of interest so prevalent in this town continue? It is noticed even in the schools. There is not a spark of school spirit in Falmouth schools in comparison with schools of the same size elsewhere.

The sooner the people of Woods Hole wake up to the realization that cooperation and a little interest will bring about a decided and pleasant metamorphosis the sooner will Woods Hole become a more friendly and enjoyable place to live.

—*F. E. McInnis*

AN OPEN LETTER TO THE FALMOUTH BOARD OF TRADE

Gentlemen:—

On July 3 we addressed a letter to you asking authority to solicit advertising in the Town of Falmouth for THE COLLECTING NET. On July 16 you wrote that:

> Subsequent to your hearing before the Advertisers Protective Committee of the Falmouth Board of Trade, the Committee voted that I should notify you that they withheld indorsement of your advertising program on the same grounds as in previous years.

The last line of your letter naturally caused us to consult our files for the last letter you wrote to us, and we found that last year you wrote:

> This is to certify that Miss Margaret S. Griffin, representing THE COLLECTING NET has the authority from the Protective Committee of the Falmouth Board of Trade to solicit advertising.

To the editor of a scientific magazine the "grounds" for withholding endorsement of our advertising program do not seem sound. We shall deeply appreciate it if you will write amplifying the reasons for your unwillingness to sanction THE COLLECTING NET as a worthwhile medium for announcing the products of your members.

In asking for reconsideration of the matter may I call attention to the fact that the last issue of THE COLLECTING NET contained more paid local advertising than any one in the history of the journal. To us it seems scarcely possible that so many members of your organization could misjudge its value. Possibly you have information which indicates that they are wasting their money by spending it to purchase advertising space in THE COLLECTING NET. If that is the case it is the duty of the Board of Trade to make the facts known so that its members will not succumb to any fraudulant statements that we may make.

The circulation of THE COLLECTING NET is growing by leaps and bounds, but the journal can not hope to retain its subscribers unless it is conducted upon a sound and ethical basis. Therefore, any advice and criticism—candidly given—will be gratefully received.

(Continued on page 114)

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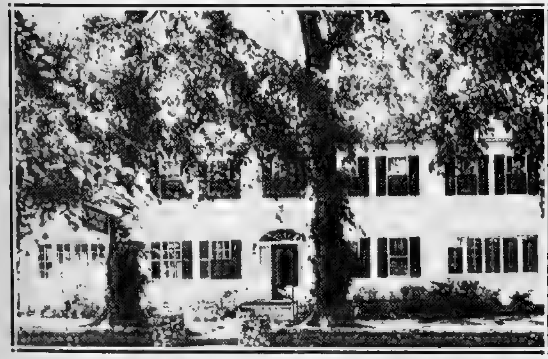

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THE WOODS HOLE LOG

THE PENZANCE FORUM

At 3:30 on Sunday afternoon, July 19, Dr. J. P. Warbasse conducted an outdoor forum at his Penzance Point estate on the subject of cooperatives. Dr. Warbasse, the first speaker, outlined the theory and purpose of cooperatives. Mr. R. N. Benjamin of the Pennsylvania cooperatives discussed cooperatives as exemplified in an Indiana oil company; he pointed out, for example, the great saving made by members of this cooperative on a product made according to a standard formula. Mr. Metzger, editor of the *Pennsylvania Farm Journal,* dealt with cooperatives as applied to insurance and stressed the fact that private insurance companies have adopted the reforms made.

According to the speakers about 2% of the American population belongs to cooperatives and about one-third of the workers of England.

The subject of the meeting on Sunday, July 26, will be "American Agriculture, the No Man's Land of our Civilization."

According to Mr. Robert Goffin, director of the Woods Hole station four thousand, seven hundred and eighty-five visitors registered at the United States Bureau of Fisheries Aquarium at Woods Hole last month. This is probably only a small percentage of the actual number who came to the aquarium; most visitors neglect to sign.

The Penzance Players conducted tryouts last Wednesday night for the cast of "Crab Apple" their summer presentation. Those people tentatively chosen for parts are Albert Borden, Jr., Betty Copeland, Peggy Clark, Mary Meigs, Garrett McClung, David Smith, and Thomas Faunce. The first rehearsal will be held Monday, July 27.

Last week we printed a report of the accident on Sippewissette Road involving Dr. McClusky's car. Photographs obtained by Dr. Irving came out well; next week we hope to be able to print pictures showing the skid marks on the road, the damaged car and the displaced telephone pole.

The residents who use Nobska Beach owe Mrs. Henry Fay a vote of thanks. She has built a hardened surfaced road in order that cars may be parked without the danger of becoming embedded in the soft sand—and the grounds around the bath house have been improved a great deal. Although the beach is a private one Mrs. Fay has been kind enough to allow residents to use it.

TRAFFIC IN WOODS HOLE. III.

It has been reported to me—although, frankly, I can scarcely believe it—that Chief Baker of the Falmouth Police Department was observed peeking through one of the dusty windows of the Community Hall the other afternoon. The rumor further states that he had a watch in his left hand, a pad of paper on his knee and a chewed black pencil in his right hand. His worried brow was deeply furrowed—so the story runs—when the president of the corporation of the largest laboratory on Cape Cod was held up in his car behind a truck which was stopped by a yellow station wagon (from Penzance) which could not proceed because one of the town tailors had parked his car near the Community Hall. Pouring (like frigid molasses!) toward the Bureau of Fisheries car after car wended its way slowly, yet impatiently, for they wanted to look at Mr. Goffin's beautiful fish. With frightful vividness a terrible picture etched itself upon my mind—what if the tinder-box-Drew-House burst into flames. The fire engine would be forced to pour (like frigid molasses!) along after the other cars (which were afraid of getting their mud guards scraped); the procession being further slowed because each driver was sticking his head out of the window to see which way the engines were going to go.

—*C. N.*

EDITOR'S NOTE: Some criticised us for printing C. N.'s note last week because it was "too flippant." However, we are printing another from him and he threatens to write a fourth next week. We should like the opinion of our readers as to whether we should take space from our columns to print these questionable letters from C. N. Shall we put his next communication in the wastepaper basket?

BOARD OF TRADE LETTER

(Continued from page 112)

We deem the matter of so much importance to the merchants of Falmouth and the readers of The Collecting Net that we are purchasing advertising space on the front page of *The Falmouth Enterprise* for July 30 to reproduce this letter. Furthermore, we are making reservations for the same space in following issue in which to print your reply.

We shall be under great obligations to you for your prompt reply.

Very truly yours,

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(Signed) *Ware Cattell, Editor*

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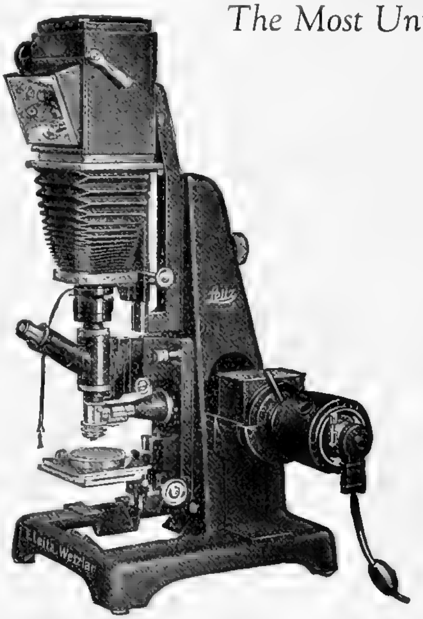

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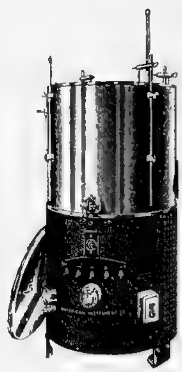

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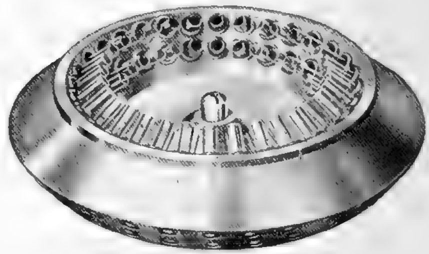

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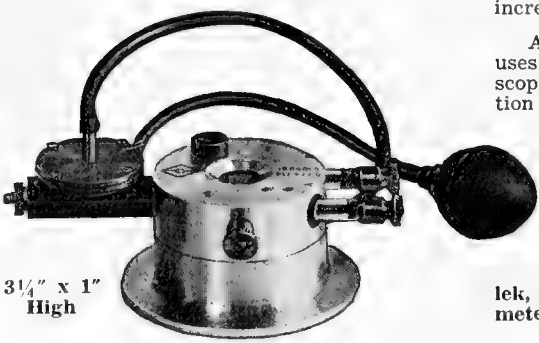

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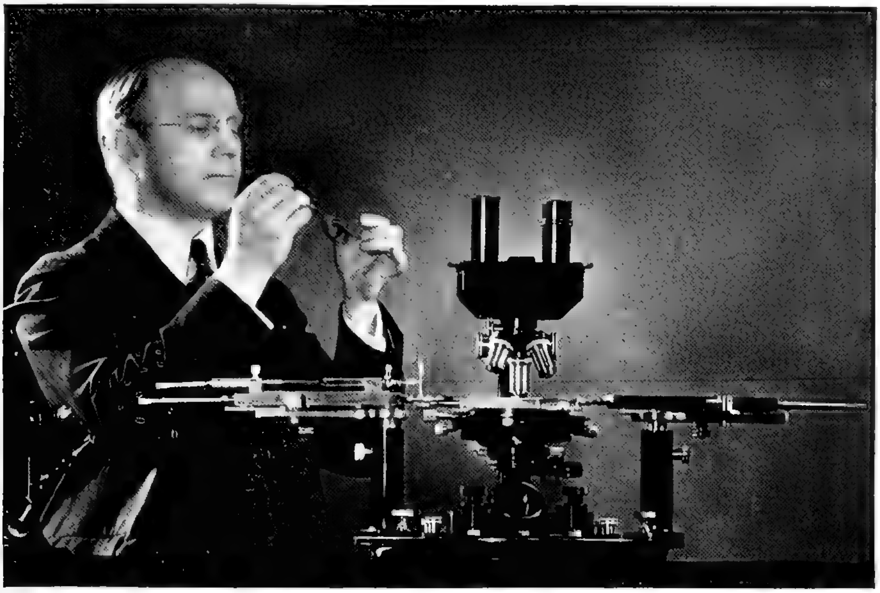

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** Dr. Van Heurck was President of Belgium Microscopical Society and a Fellow of the Royal Microscopical Society and others.*

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THE COLLECTING NET

Vol. XI, No. 5 SATURDAY, AUGUST 1, 1936 Annual Subscription, $2.00 Single Copies, 30 Cents.

A QUANTITATIVE ANALYSIS OF ANTERIOR PITUITARY-OVULATION RELATION IN THE FROG: RANA PIPIENS

Dr. Roberts Rugh

Instructor in Zoology, Hunter College

Since the original work by Dr. Opal Wolf in 1929, ovulation has been induced in an increasing variety of amphibia. In 1934 it was first suggested that while either male or female glands could be used to induce ovulation, that there was a potency difference favoring the female anterior pituitary. Since the response to anterior pituitary injection was not uniformly dependable, it seemed desirable to study this relationship quantitatively.

The work was divided into two phases; first, an attempt was made to determine any correlations between sex, body weight, body length, gonad weight, and anterior pituitary weight. The second phase was a study of the degree of ovulation elicited by quantitatively determined doses of the gland.

Over 700 frogs were used, covering two periods: November and February. These months were chosen as representing the beginning and the end of the normal hibernation period. Since it was found (*Continued on page* 126)

M. B. L. Calendar

TUESDAY, August 4, 8:00 P. M.

Seminar: Dr. Ethel Browne Harvey: Development of arbacea eggs without nuclei: Parthenogenetic merogony.

Dr. F. Meser: Central changes in arbacea eggs during fertilization —a moving picture.

Dr. H. J. Fry: Temperature effects on mitotic changes in arbacia eggs.

FRIDAY, August 7, 8:00 P. M.

Lecture: Dr. J. K. W. Ferguson: Newer Views of CO_2 Transport and Their Significance to Other Physiological Processes.

BIOLOGICAL RESEARCH AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

Dr. Claude E. ZoBell

In Charge, Biological Program

At the time his retirement from the University of California becomes effective in August 1936 Dr. T. Wayland Vaughan will leave to his successor, Dr. Harald U. Sverdrup, a scientific organization which has expanded rapidly during his administration to include all aspects of oceanographic research. Since his appointment as director of the Scripps Institution of Oceanography in February 1924, Dr. Vaughan has gradually developed an extensive research program in biological oceanography. Being himself an authority on corals and foraminifera and recognizing the importance of all biological entities in the metabolism of the sea, Dr. Vaughan has devoted particular attention to biological research. He has been instrumental in assembling a staff of well-trained biologists who are working cooperatively with the chemical, physical, geological and dynamical oceanographers to advance our knowledge of the "other two-thirds of the world," the ocean. While it has been the

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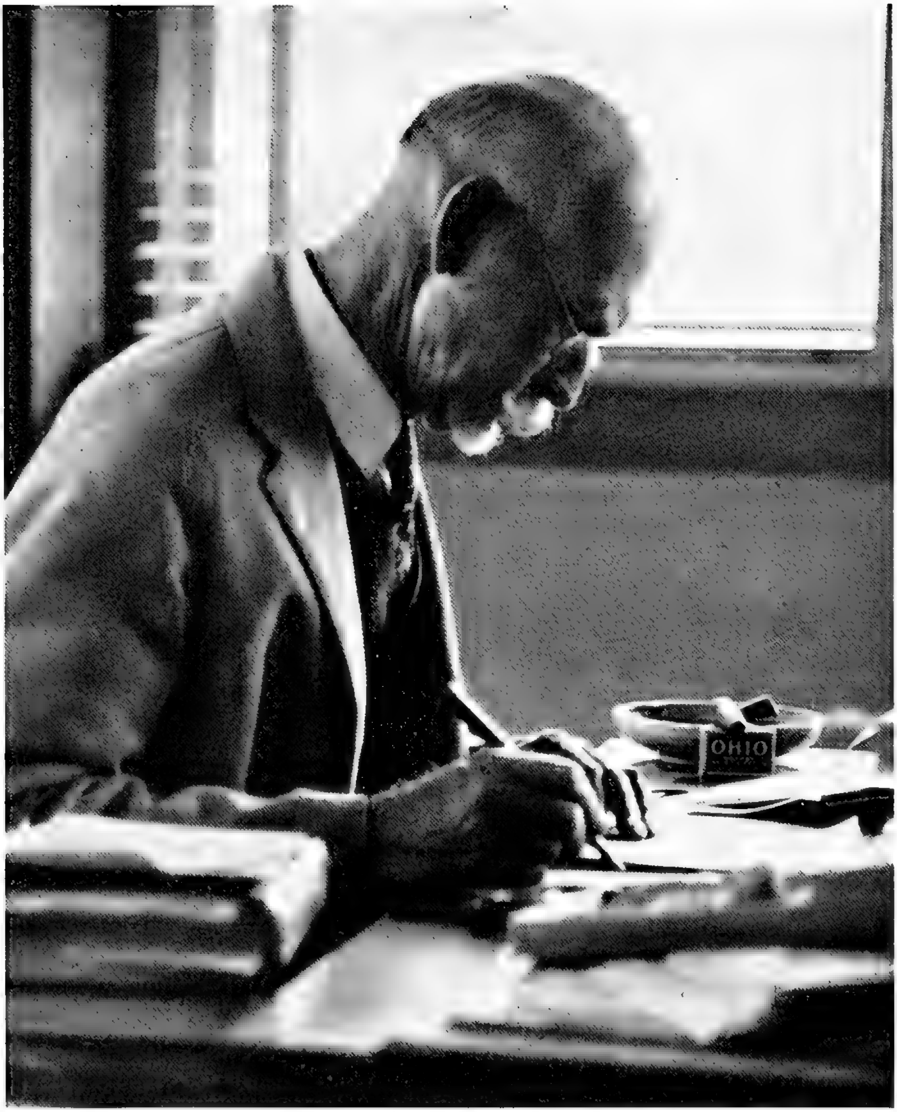

DR. T. WAYLAND VAUGHAN

Retiring director of the Scripps Institution of Oceanography, who recently received the Agassiz medal from the National Academy of Sciences, and LL.D. degrees from the University of British Columbia and the University of California in recognition of his outstanding work as an investigator and organizer.

policy of the Institution to allow the staff members a high degree of freedom in the selection of problems for investigation, it has been the common objective of all to contribute to the science of the sea and its relation to man.

During the directorship of Dr. Vaughan the biological research program has been expanded and improved in several ways. Additional personnel has been appointed to provide specialists in bacteriology, fishes and other vertebrates, invertebrates, paleontology, physiology, phytoplankton and zooplankton. More adequate laboratory facilities have been made available as described in The Collecting Net (8:2-7, 1933). The supply of running sea water has been enlarged and improved in quality. By the installation of diesel engines in the boat *Scripps* its cruising speed and range and its safety have been increased, thereby extending its usefulness for the collection of samples and oceanographic data. The laboratory quarters as well as the living accomodations on the boat have been remodeled and an electrically-operated hoisting device installed with enough cable to take water and bottom samples and temperature records from depths as great as 4500 meters and enough large cable to dredge to depths of 1000 meters. Perhaps the greatest improvement during Dr. Vaughan's administration has been made in the library which now contains over 14,600 volumes, 1100 charts and 30,000 pamphlets. He has contributed to the Institution his own personal collection of 1800 volumes and 6000 reprints of relevant literature besides numerous periodicals. The library subscribes to 74 periodicals and receives 236 others on an exchange basis besides 18 periodicals which are presented as gifts. Reports on nearly all of the important oceanographic expeditions have been or are being obtained. Although there is still much to be desired, the Scripps Institution library is one of the finest of its kind in the world.

The broad scope of the research program in biological oceanography may be judged from the following summary of projects upon which work has been done during the year.

Dr. Martin W. Johnson, who has recently taken charge of the zooplankton work, has published a report on the seasonal migration of the woodborer, *Limnoria lignorum* in northern waters. Likewise he has completed a paper on the developmental stages of the oceanic copepod, *Eucalanus elongatus* var. *bungii*. Additional study is being made on the status of the varieties of this species collected at various stations from Panama to the Arctic Ocean. Dr. Johnson is continuing his observations on the zooplankton off the California coast with particular reference to seasonal production, relation to the oxygen minimum layer and other environmental factors. Cultural experiments to determine the life cycle of the littoral copepod, Thisbe, and of the pelagic copepod, *Tortanus discaudatus*, are in progress. Investigation of the fouling organisms in the Institution's salt-water system are being continued.

In collaboration with N. A. Wells and later with Peter Doudoroff, Dr. F. B. Sumner, in charge of biology of fishes, has continued the investigations on the respiratory metabolism of marine fishes with special reference to its relation to their susceptibility to certain anaesthetics and lethal agents. Investigations on the quantitative study of melanin production in fishes as influenced by varied conditions of background and incident light have been commenced. The intake and output of water and salts by euryhaline fishes in different concentrations of sea water is being studied. In collaboration with D. L. Fox, the influences of certain stimuli on the accumulation of carotenoids in the tissue of fishes are being investigated. Professor R. B. Cowles from the University of

DR. HARALD U. SVERDRUP

Famous oceanographer and Arctic explorer, who becomes director of the Scripps Institution September 1, 1936.

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California at Los Angeles devoted part of last summer to special investigations on fishes and Dr. B. M. Allen from the same University has been continuing his studies on the hypophysis of fishes at the Institution.

Percy S. Barnhart, curator of the biological collection, has completed a monograph on "Marine fishes of Southern California" which is illustrated by 292 figures. In the aquaria tanks about 855 fishes and several hundred invertebrates including over 50 species have been exhibited. A large collection of mounted fishes has been on exhibit in the California State Building at the San Diego Exposition. Various shells, corals, mounted fishes and other marine organisms have been added to the Institution's fine museum collection during the year.

Professor W. E. Allen is continuing his observations on the number and kind of phytoplankton collected daily from the piers at the Institution and at Point Hueneme. He has such data for fifteen consecutive years. A report covering certain general features in the studies of the first ten years has been published. He has also prepared a report covering the outstanding results of the study of the diatom collections obtained by Dr. Roger Revelle on his mid-Pacific cruise on the U. S. S. *Bushnell* in 1934. A taxonomic report on the diatoms from the Sea of Java has been published in collaboration with Dr. E. E. Cupp. The pertinent results of the experimental studies on "fouling organisms" carried on in cooperation with Dr. W. R. Coe of Yale University have been submitted for publication. Miss Sonia Ladoff from the Allegheny High School of Pittsburgh has been making observations on the plankton, algae and other microorganisms of the Pacific coast.

Dr. E. E. Cupp has completed a paper entitled, "Seasonal distribution and occurrence of marine diatoms and dinoflagellates at Scotch Cap, Alaska." She has given particular attention to the centrifuge method of phytoplankton analysis. The effect of low concentrations of deuterium oxide on the growth of two species of the marine diatom genus Nitzschia has been investigated and a paper on this subject in collaboration with Dr. Fox and Dr. McEwen has been published.

Although not a staff member, M. L. Natland has continued to work with the Institution in a study of the ecology of the living foraminifera in the Gulf of Catalina. Dr. Vaughan assisted by Dr. W. S. Cole and U. S. Armstrong has completed several papers on fossil foraminifera. Particularly meritorius has been the work on the stolon systems of the foraminifera as a criterion for their classification. Dr. Shoshiro Hanzawa from the Tohoku Imperial University has been studying the orbitoidal foraminifera in collaboration with Dr. Vaughan, and F. B. Tolman spent several days studying the Institution's foraminifera collection. Dr. Earl H. Myers, now professor of zoology at Compton Junior College, has continued his work on life cycles in the Foraminifera.

In the physiological laboratories, Dr. D. L. Fox is pursuing studies on the carotenoid pigments of marine organisms. In collaboration with Dr. Sumner it has been demonstrated that certain optical environmental factors affect the amounts of xanthophyll stored by *Girella nigricans,* and that *Fundulus parvipinnis* lost none of its xanthophyll when maintained for long periods on a carotenoid-free diet and increased its quantities of xanthophyll when fed either the latter carotenoid or carotene. Jointly with Dr. Young it has been found that certain surf perches selectively absorb only one of the three different carotenoids in a species of shrimp which the perches consume. A xanthophyll ester is hydrolyzed in the gut, stored in a re-esterified condition in the skin and fins, and any excess temporarily stored in an unesterified condition in the rectal segment of the gut. Dr. Fox has published results indicating that heavy water has little or no influence on the activity of certain enzymes. Working with Dr. R. Craig a slight enhancement by heavy water of the enzymatic hydrolase of starch was observed. Dr. Fox, Dr. E. E. Cupp and Dr. G. F. McEwen report that heavy water seems to retard the growth rate of the diatom, *Nitzschia bilobata*, but apparently stimulates that of *N. closterium.* A 64 page paper on the habitat and food of the California sea mussel has recently been published. Prior to his resignation in October, Dr. G. W. Marks made important contributions to our knowledge of the catalase of marine animals and plants as well as on the comparative copper content of various marine molluscs.

In microbiology, Dr. Claude E. ZoBell has continued his studies on the measurement of the oxidation-reduction potentials of sediments as influenced by bacterial activity. The O/R potentials of strata from different depths as well as the vertical distribution of aerobes and anaerobes has been published. Assisted by D. Q. Anderson, the vertical distribution and relative abundance of bacteria in marine sediments which activate the following physiological processes of oceanographic significance have been estimated:—ammonification, nitrate-reduction, denitrification, nitrification, urea-fermentation, cellulose-decomposition, chitin-digestion, fat-hydrolysis, sulfate-reduction, starch-hydrolysis, and various hydrolytic processes. It has been found that bacterial activity as manifested by CO_2 evolution, NH_3 production, NO_3 reduction and bacterial multiplication is greater in small than in large volumes of sea water because of the periphytic habits of marine bacteria. The investigations of Miss W. A. Landon indicate that mussels, barnacles and other marine animals

can subsist on a bacterial diet. Mrs. C. Feltham has continued the work on the specificity of marine bacteria. Miss Helen Mathews, a summer visitor from the University of British Columbia, finds that the types of bacteria found in air are indicative of whether air masses are of marine or terrestrial origin. Mrs. Alice Callaway is working on the filter-ability of bacteria and the osmotic pressure tolerance of marine *vs.* freshwater forms. An autochthonous bacterial flora in Great Salt Lake has been demonstrated by the direct microscopic procedure in collaboration with W. W. Smith of the University of Utah. Dr. Blodwen Lloyd spent several months at the Institution while on sabbatical leave from the Royal Technical College of Glasgow studying denitrification and the factors which influence the activity of bacteria in stored sea water.

Dr. R. T. Young, a visiting scientist who has been working in the Institution laboratories during the last two years, has been especially interested in parasites. He has collected and preserved for future reference a large number of cestodes from fishes and birds. The life histories of the trematode, Levinsella sp., from the godwit (*Lcimosa fcdoa*) and an indeterminate trematode from the surf perches (Embiotocidae) have been partially determined. A fork-tailed cercaria from the Bering sea has been described. Dr. Young is also investigating the influence of pH, distilled water and various salt solutions on fish to determine the cause of their death. Various pathological effects including chemical changes in the blood which may induce asphyxia have been observed but it is not known yet whether these effects cause death or if they are merely incidental.

La Place Bostwick, a special resident investigator, has published the results of his successful cultivation of pearls in abalones. Dr. Chin Chih Jao of the Rockefeller Foundation in Natural Sciences devoted several months to the study of local sea-weeds and to learning modern oceanographic methods. Professor Loye Miller from the University of California at Los Angeles has taken advantage of the cruises of the boat *Scripps* to collect data on near-shore birds. Harold Pratt and Irving McClurkin, both from the University of Colorado, have been studying the invertebrates of the intertidal zone.

During the year 22 papers have been published on subjects appertaining to biological oceanography, eight others have been accepted for publication and a dozen are in preparation.

A QUANTITATIVE ANALYSIS OF THE ANTERIOR PITUITARY-OVULATION RELATION IN THE FROG: RANA PIPIENS

(Continued from page 121)

that the anterior pituitaries varied in weight from 0.6-1.6 milligrams, in order to lessen observational error, the glands were removed from frogs of approximately the same body length and were weighed in groups of twenty.

While the body lengths of males and females averaged almost the same for November and February, there was consistent reduction in average body weight and average gonad weight, over this hibernation period. Body length, as measured from nares to cloacal opening, was the standard by which other variables were considered. It was found that males and females with body lengths less than 71 millimeters were immature; that between 71-74 millimeters there was the beginning of gonad growth and maturity; and that males and females longer than 74 millimeters showed sex differences in the relative weights of their anterior pituitaries. These differences favored the males, both in November and in February. Over this hibernation period there was considerable reduction in relative weight of the anterior pituitaries in both sexes, at some stages being as much as 29%. There is a similar reduction, over the hibernation period, of relative ovarian weights, with the greatest reduction among the smaller females. If anterior pituitary weights are plotted against ovarian weights, it is demonstrated that there are correlating reductions in the weights of these two organs, all points falling on a straight line for both November and February.

In respect to the induction of ovulation, it was found that in November 8 mgms. of male anterior pituitary induced about 42% of the eggs to leave the ovary while 5 mgms. of female gland tissue induced 85% ovulation. In February, 4 mgms. of either male or female gland tissue would induce 100% ovulation, and in doses less than this there were indicated differences in potency favoring the female gland.

The anterior pituitaries removed from females which had been induced to ovulate showed no decrease in potency in respect to inducing ovulation in other females. This supports the thesis that the injection of the hormone is comparable to the liberation of the host's hormone, and that the host's hormone is in no way affected.

If frogs are selected at random, it will be found that the average male anterior pituitary is 16% heavier than that of the average female, but is only 60% as potent in respect to inducing ovulation. This supports the thesis, first advanced in

1934, that the female glands are approximately twice as potent as those from males.

Like many biological processes, which at first seem to be simple, this relationship between the anterior pituitary and ovulation resolves itself into a number of variables: 1. Size and sexual maturity of the donor. 2. Concentration of the hormone through hibernation reduction in weight. 3. Activity of the recipient's own gland. 4. Source of the hormone, *i.e.*, from male or female. 5. Dose of the hormone (mgms. of gland tissue). 6. Size and sexual maturity of recipient, and 7. Size and susceptibility (maturity) of the ovaries to ovulation induction.

This quantitative study points to seasonal as well as metamorphic changes in the anterior pituitary which must be studied from the cytological point of view. This study is being made on the bullfrog, *Rana catesbiana*, and will be reported subsequently.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 21).

THE EFFECT OF IONS ON THE NERVE MEMBRANE POTENTIAL

DR. WALTER WILBRANDT

Rockefeller Fellow in Physiology, University of Pennsylvania

The injury potential has been interpreted by the assumption of a selectively ion permeable membrane, surrounding the cell and separating different electrolyte solutions inside and outside. Investigating the effect of inorganic ions on the injury potential of the frog's sciatic nerve and using this interpretation, Netter (Pflügers Archiv 218, 310 (1927/28)) came to the conclusion that the nerve membrane must be exclusively cation permeable, since he obtained a change of the potential only by varying the cations, whereas changing the anions had no effect.

Extension of this work in two directions seemed desirable. With regard to the question of the rôle of the membrane in impulse propagation it seemed desirable to know whether the (histologically very different) membrane of the non-myelinated nerve would behave similarly. Furthermore it seemed desirable to obtain information as to whether organic ions can influence the potential. Parts at least of the electrical disturbance during activity, the after potentials, seem to be connected with the metabolism of the nerve, which connection might be based on the formation of ionised metabolites, acting on the membrane potential.

The experiments were done on leg and claw nerves of the spider crab, with a technique not essentially different from that used by Netter.

The action of inorganic cations was found to be essentially similar to Netter's results, the effect decreasing in the series $Rb > K > Na = Li$. Inorganic anions, however, in contrast to Netter's results, had a marked, though slight effect, indicating the series $Cl = Br < NO_3 < SCN$. Diffusion potentials have been shown not to be responsible for the effect, and the effect of lowering the concentration of potassium has been taken into account. The membrane of the investigated non-myelinated nerve therefore seems not to be exclusively, though predominantly, cation permeable.

Organic cations do affect the potential, the effectiveness lying between that of Na and K, in the approximate order: choline = tetramethylammonium < dipropylammonium < dimethylammonium = diethylammonium < tetraethylammonium < guanidine < dibutylammonium < diamylammonium. Thus, ascending in the homologous series of the dialkylamines, there appears first an increase, then a decrease of effect.

If we assume that we are dealing with some sort of porous membrane, to some degree analogous to the porous dried collodion membrane of Michaelis, this may be accounted for in the following way. The lower members of the series act according to their ionic sizes. The strong action of the higher members is due to their increasing accumulation at the interface. Stalagmometric measurements of the interfacial tension between aqueous solutions of dialkylammonium salts and liquid petrolatum show an increasing accumulation at this interface. Höber's results on the rate of penetration of organic salts into erythrocytes indicate that similar accumulations can take place also at biological interfaces. In his experiments with organic anions a fairly close correspondence could be seen to the action of the salts on the potential across an anion permeable impregnated collodion membrane. Likewise the effect of the organic cations discussed above on the collodion membrane potential agrees qualitatively with their effect on the nerve potential.

Organic anions were also shown to affect the potential, which seems interesting in view of the possible connection between after potentials and metabolism. The soaps acetate, propionate, butyrate, as well as lactate and pyruvate, proved effective. The effects are about as strong as that of SCN, the most effective inorganic anion.

STAFF MEETING AT THE OCEANOGRAPHIC INSTITUTION

Mr. Columbus O'D. Iselin of Harvard University and the Woods Hole Oceanographic Institution spoke on some results of the German *Meteor* expedition at the staff meeting on July 9th.

The reports from this expedition are still being worked up in Berlin at the Institut für Meereskunde and although far from being finished, they already contain some excellent ideas new to Oceanography. One of the main difficulties with such a monumental and voluminous piece of work is that it may be accepted in its entirety for some time to come and without the benefit of constructive criticism from outside sources. But, because of their completeness, the *Meteor* reports mark the end of the first period of the Oceanographic Exploration of the Atlantic Ocean.

The newness of the methods used in these reports is noticeable particularly in Vol. 6 on "The Stratification and Circulation of the Atlantic Ocean" by Wüst and Defant. This work consists of three papers, each with atlases, bearing the following titles:

1) The Bottom Water and Structure of the Atlantic Deep Sea.—Wüst.
2) The Stratosphere.—Wüst.
3) The Trophosphere.—Defant.

The "Stratosphere" is a term used to signify the deeper layer of the ocean and the "trophosphere" the upper layer. These terms, according to Mr. Iselin, were not very satisfactory, for the ocean is not quite that easily apportioned. The terms are more easily justified in meteorology where they originated.

In the ocean the thermal characteristics are just the reverse of those in the atmosphere, but the vertical stability thereby produced is not comparable; the speaker making the specific differences in this respect between the two media clear by illustrations and charts.

The ocean being divided into the stratosphere and the trophosphere, there must of necessity be a dividing line between the two regions, and hence 8° isotherm was settled on as a suitable boundary in the Atlantic. The water just above and just below this particular layer, although quite important, was somewhat neglected in Wüst's treatment of the situation. It is this layer having temperatures between 5° and 11° that is most affected by circulatory movements. Iselin, therefore, prefers a three-layer division of the ocean.

Wüst's stratosphere paper is monumental; he has traced the deep water movements in three dimensions. It is well to mention here that deep water movements in the sea start with the character of tongues. The distance a tongue can be followed as a maximum or minimum is not great, because the physical characteristics soon disappear through mixture. The movements can be traced further, however, by the salinity-anomaly method.

There are several deep movements of ocean water traceable through salinity. Thus, the South Atlantic Ocean can be shown to receive water from the North Atlantic at mid-depths; off Gibraltar the salinity is at a maximum at 1200 meters, but as one proceeds southward, the water becomes gradually fresher. Wüst has traced this deep current to high southern latitudes, where through chilling this water sinks to the bottom and flows northward again. There is nothing really known about the actual rate of movement of these currents.

The chief criticisms of Wüst's paper are: (1) oxygen is not always a reliable method for tracing deep currents; (2) the whole story of deep movements is not yet known; (3) no one method has yet been developed for solving all the types of movements found in deep water.

The objections to Defant's paper next taken up by Mr. Iselin are: (1) we do not yet know the effect of the seasonal and annual changes in the upper 300 meters of water in low latitudes; (2) the observations from different years and at different seasons can't always be combined for reliable conclusions; (3) the surface layer studied by Defant is about 18,000 times as wide as it is deep, causing tremendous distortion of water layers in any diagrams showing the vertical changes of temperature, salinity or oxygen content; (4) the relative importance of the frictional effect of the wind and the horizontal variations of surface density are not yet known. One might conclude from this paper that the surface layers are far more complicated than ever thought of before and that the complexity of surface movements in low latitudes is tremendous.

In closing, Mr. Iselin stated that the oceanographers of the *Meteor* today, although they have made great strides, are not always in accord with the oceanographers of other countries, and that although at least ninety percent. of the *Meteor* papers described are acceptable, he had tried to point out wherein the remaining ten percent. could be easily misinterpreted.

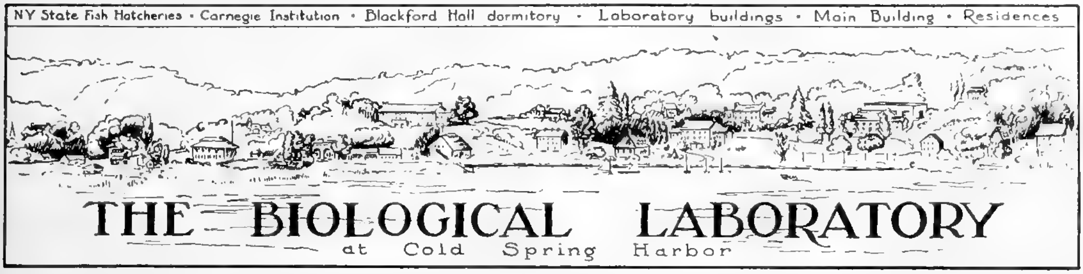
A very interesting discussion was held after the speaker finished, the following questions being asked:

Dr. Bigelow—What is the effect of the drift of larval eels in relation to the current? How do they drift to Europe as they have no mechanism to get them along from the western part of the Sargasso Sea to the European coastline?

Dr. Allen—What is the relationship between the outflow of big rivers into the ocean and surface currents?

(Continued on page 130)

NEWS OF BIOLOGICAL STATIONS OUTSIDE OF WOODS HOLE



DIRECTORY OF THE BIOLOGIGAL LABORATORY, COLD SPRING HARBOR

STAFF, INVESTIGATORS, AND ASSISTANTS

* Summer Staff.
** All-year Staff.

Abels, Julius, Assistant—N. Y. U. Medical College.
***Abramson, Harold A.**, Research and Instruction—College of P. and S., Columbia University.
Bacon, Annette, Assistant—Temple University.
***Blanchard, E. W.**, Instruction—Bryn Mawr College.
***Cain, Mildred**, Administration.
***Cain, Stanley A.**, Instruction—University of Tennessee.
***Castle, William A.**, Instruction—Brown University.
***Cole, Kenneth S.**, Research and Instruction—College of P. and S., Columbia University.
***Corner, George W.**, Instruction—University of Rochester School of Medicine.
***Cunningham, Bert**, Research—Duke University.
***Curtis, Howard J.**, Research—College of P. and S., Columbia University.
****Fricke, Hugo**, In charge Biophysics—The Biological Laboratory.
****Gallagher, D. M.**, Radio Engineer—The Biological Laboratory.
Goldblatt, Harry, Research — Western Reserve University School of Medicine.
****Goldsmith, Thomas T., Jr.**, Physicist—The Biological Laboratory.
****Grout, A. J.**, Bryologist—The Biological Laboratory.
Guttman, Rita, Assistant—College of P. and S., Columbia University.
****Harris, Jane D.**, Administration—The Biological Laboratory.
Hinchey, M. Catherine, Research—Temple University and University of Pennsylvania.
Iluene, Elizabeth, Assistant—Duke University.
Jahn, Theo., Research—State University of Iowa.
Katz, Rudolph, Research—Massachusetts Institute of Technology.
****Klem, Dorothy**, Administration—The Biological Laboratory.
Laity, Elsie, Research—Temple University.
***Lytle, Theodore**, Administration—Harvard Medical School.
****MacLeod, John**, Assistant—The Biological Laboratory.
***Marsh, Phronsie**, Administration—The Biological Laboratory.
Morris, Samuel, Research—Temple University.
***Moyer, Laurence**, Research and Instruction—Yale School of Medicine.
****Ponder, Eric**, In charge of Physiology and interim Director—The Biological Laboratory.
***Schaeffer, Asa A.**, Research—Temple University.
****Smith, Homer**, Chemist—The Biological Laboratory.
***Smith, T. L.**, Research—College of the Ozarks.
Spencer, J. M., Assistant—College of P. and S. Columbia University.
***Spieth, H. T.**, Instruction—College of the City of New York.
***Taylor, I. R.**, Instruction—Brown University.
***Van Cleave, H. J.**, Instruction—University of Illinois.
****Van Olinda, Ruth**, Administration—The Biological Laboratory.
***Walzl, Edward**, Assistant—Johns Hopkins University.
Yeakel, Eleanor, Research—Bryn Mawr College.
Young, John Z., Research—Oxford University.

STUDENTS

Avis, Frederick, Instructor—Worcester Academy.
Barrett, Harold, Undergraduate—Brown University.
Batlin, Alexander, Graduate student—Johns Hopkins University.
Bell, W. Randal, Graduate student—New York University.
Berg, Milton, Undergraduate—Brown University.
Brown, Mary J., Assistant Professor—University of Wyoming.
Bruner, Jerome, Undergraduate—Duke University.
Candon, Basil, Graduate student—University of Vermont.
Conklin, Ruth E., Assistant Professor—Vassar College.
Cummins, George M., Jr., Instructor—St. Ambrose College.
Davidson, David L., Graduate student—Brown University.
Dow, Thompson, Undergraduate—St. John's College.
Green, Earl, Graduate student—Brown University.
Kreezer, George, Research Associate, Training School—Vineland, N. J.
Jones, Sarah, Instructor—Vickery High School, Texas.
McCoy, Francis, Undergraduate—Ohio State College.
McLean, Walter, Undergraduate — University of Pittsburgh.
Meyer, Eugene, Undergraduate—Yale University.
Nelson, Mary, Graduate student—Tulane University.
Rakov, Jerome, Undergraduate—Cornell University.
Randall, H. Thomas, Undergraduate — Princeton University.
Reichel, John, Jr., Undergraduate—Princeton University.
Richardson, Philip, Instructor—Simmons College.
Roh, Charles, Undergraduate—Princeton University.
Savage, Eric, Undergraduate—Harvard.
Siegel, Adele F., Undergraduate—Hunter College.
Stewart, Walter A., Undergraduate — Dartmouth College.

FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

(Received, July 30)

Recent visitors at the Laboratory have included Dr. Frederick Bedell, Dr. and Mrs. F. A. Gibbs, Dr. and Mrs. W. G. Lennox, Dr. G. H. Parker, Dr. C. Ladd Prosser, Dr. N. Rashevsky, Dr. B. H. Willier.

Dr. J. R. Katz lectured on Thursday, July 23rd on "The Application of Ultraviolet Spectroscopy to Biological Problems." On Tuesday evening, July 28th he lectured on "The Submicroscopic Structure of Starch."

Dr. and Mrs. Harry Goldblatt will be at the Laboratory for the remainder of the summer.

The annual Laboratory party was held at Blackford Hall on Friday evening, July 17th. Entertainment, aside from dancing and refreshments, included an orchestra composed of Mr. D. M. Gallagher, Dr. E. W. Blanchard, Dr. Morton Rubin, and some neighborhood talent; some Argentine tangoes by Dr. José Odoriz and Miss Vivian Behrmann; a trick by Dr. Hudson Hoagland; folk songs by Dr. Georges Coppée, who accompanied himself with the guitar; songs by Miss Marjorie Van Olinda and Mr. Gallagher.

The men's tennis tournament was won by Mr. Eugene Meyer, who defeated Dr. E. W. Blanchard in the finals; Mrs. Hudson Hoagland defeated Miss Eleanor Yeakel to win the women's tournament. Dr. R. W. Gerard was the winner of the ping-pong tournament, and Mr. John MacLeod of the pool; the runner-up in each of the last two was Mr. Philip Richardson.

Dr. Harold Abramson and Dr. Laurence Moyer have talked at the Carnegie Institution Journal Club meetings recently on various phases of electrokinetics.

STAFF MEETING AT THE OCEANOGRAPHIC INSTITUTION

(Continued from page 128)

Dr. Rossby—How do the European and American eels separate in going to Iceland and Greenland respectively?

Dr. Renn—What is the relationship of oxygen, plankton production, etc. to the figures on Wüst's diagrams?

Dr. Bigelow—How is the oxygen-deficient layer at 800 meters interpreted in Wüst's report?

Donald Zinn

NOTES FROM THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received, July 21st)

Dr. N. W. Cummings, Department of Physics, San Bernadino Junior College, arrived on Wednesday of last week to complete the development of his instrument for recording solar radiation. He plans to work at the Scripps Institution for the next six weeks, making use of the instrumental equipment here for comparisons with his instruments. In his observations he is including measurements of evaporation of water which depends upon radiation.

Dr. Martin W. Johnson has returned from a two-weeks' trip with the U. S. Coast and Geodetic Survey steamer *Guide* off Cape Mendocino, on which he made oceanographic observations, collecting water, plankton and bottom samples at about twenty stations, besides making hydrographic observations at five stations.

Dr. E. G. Moberg and family have returned from vacation in British Columbia. During their absence Dr. Moberg attended the meetings of the American Association for the Advancement of Science, the Oceanographic Society of the Pacific, and the Western Society of Naturalists, all of which were held in Seattle in June.

Dr. and Mrs. Richard H. Fleming have returned from their vacation trip to Victoria, B. C., Dr. Fleming's old home. Dr. Fleming also attended the scientific meetings in Seattle.

Mr. M. L. Natland of the Shell Oil Company at Long Beach visited the Scripps Institution on Saturday for a conference regarding his work on living foraminifera of this region.

Dr. and Mrs. Nelson A. Wells are visiting the Scripps Institution for a few days. Dr. Wells was formerly a research assistant here, working on physiology of fishes with Dr. F. B. Sumner. While here they are guests of the Sumners.

On Monday, Commander G. A. French, R. N., and Lieut. Commander T. A. Holden, R. N., from H. M. S. *Apollo*, came to visit the Scripps Institution with Mr. M. J. Walsh, chemist of the Kelp Laboratories of San Diego. They were especially interested in the hydrographic work of the Institution.

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

THE MARINE INVERTEBRATE COURSE AT THE MARINE BIOLOGICAL LABORATORY

Dr. T. Hume Bissonnette
Instructor in Charge; Professor of Biology, Trinity College

This course differs from the courses in Invertebrates usually given at the Universities and Colleges throughout the country in that its objectives are at least three-fold. It presents enough of the comparative anatomy of the invertebrates, as determined by observation and dissection of the conventional forms together with much more varied materials than are possible in most colleges, to enable those who have not taken such courses to learn at first hand the fundamentals of invertebrate structure; for more advanced students it furnishes a review of this in sight of living material. In the second place, from the study of many forms in the living and active condition, the general physiology and behavior of these forms are brought to the attention of students. But perhaps the most important objective and part of the course is the study of animals in the field in their various habitats and associations. It enables the students to learn by name and to recognize at sight many of the more common or interesting species native to the district and to become conversant with their classification and specific characteristics. This is facilitated by the use of keys, prepared by the staff of the course, for rapid identification of common species belonging to the various phyla. This part of the course lays a foundation for the more specialized studies on Embryology, Physiology, and Ecology.

This third part of the course is presented on field trips for which the class is divided into six teams. Each member of a team is taught to use one or more implements on each trip, aiding the team in finding, identifying, and learning the habits and preferred habitats of a comparatively large number of species in each region visited. Each team of nine students is accompanied by a different instructor on each excursion. These instructors are interested in different aspects of biology and in different groups of animals. As in the laboratory, the method of attack upon the problems in the field differs with different instructors, thus each team comes under the influence and guidance of at least six different instructors or members of the staff on field trips and of nine in the laboratory.

The animals of the different Phyla will be studied in the following order: Protozoa, Porifera, Coelenteratos, Ctenophores, Platyhelminths, Nemerteans, Nematodes, Annelids, Molluscs, Arthropods (including Limulus), Bryozoa, Echinoderms, and lower Chordates of the region.

Special lectures on Ecology, Marine Zoology, and Invertebrate Phylogeny will be given by members of the staff and, if possible, others by scientists working at the laboratory or visiting it.

It is planned to take field trips to the following regions: Lackey's Bay, Nobska Point, Kettle Cove, Lagoon Pond Bridge near Vineyard Haven, Cuttyhunk, North Falmouth, Tarpaulin Cove, and Hadley Harbor, where varied habitats are to be found near enough together to make it possible to study many in a short time of collecting while tide study many of them in a short time of collecting while tide is low. Students will spend half a day observing and studying animals freshly dredged up from different parts of Vineyard Sound. These studies are made directly on the materials as the dredges are emptied on the boat. Students will learn how these animals are secured, and how they are associated with each other and with different types of sea floor.

BIRD NOTES

F. N. Whitman

Interesting incidents occur on collecting trips. A large red-tailed hawk passed near me yesterday, a red-winged blackbird urging it on.

I once surprised a roughed grouse with young. They vanished. Looking down around my feet I soon made out several squatting flat. Four half grown woodcock—met on the Sippewisset Road—faded like magic on the grassy roadside. I stood two feet from them several minutes without seeing them. Finally they moved. Meanwhile the mother led a young friend of mine a ludicrous chase down the road.

The abundance of woodcock is appreciated if one is abroad after dusk in April when these snipe engage in their interesting song flights.

Several recent records of white herons (white phase of little blue heron) in Falmouth are noteworthy.

The singing of the hermit thrushes makes interior Cape points a wonderland.

SUPPLEMENTARY DIRECTORY

KEY

Laboratories		Residence	
Botany Building	Bot	Apartment	A
Brick Building	Br	Dormitory	D
Lecture Hall	L	Drew House	Dr
Main Room in Fisheries Laboratory	M	Fisheries Residence	F
Old Main Building	OM	Homestead	Ho
Rockefeller Bldg.	Rock	Hubbard	H
		Kahler	Ka
		Kidder	K
		Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY

INVESTIGATORS

Clark, J. K. Trinity. OM 28. K 5.
Dan, Jean C. grad. Pennsylvania. Br 111. Whiting, Minot.
Dan, K. res. assoc. phys. Misaki Mar. Biol. Stat. Br 111. Whiting, Minot.
Derrickson, Mary B. grad. asst. biol. Duke. Br 8. WF.
duBuy, H. G. res. fel. phys. Harvard Med. Br 233. Robinson, Quisset.
Figge, Rosalie Y. res. asst. anat. Maryland Med. Rock 6. D 210.
Fleisher, M. S. prof. bact. St. Louis. Br. 304.
Gilchrist, F. G. asst. prof. zool. Pomona (Claremont). Br 323. Cassidy, Millfield.
Gottschall, Gertrude Y. asst. biochem. Cornell Med. Br 121. D 213.
Hutchings, Lois M. teach. biol. Weequahic H. S. (Newark). Br 110-F. H 7.
Itoh, H. grad. zool. Pennsylvania. Br 220. McInnis, Quisset.
Jones, N. instr. sci. drawing. Swarthmore. Br 221. D 214.
Jones, Ruth McC. instr. biol. Swarthmore. Br 9. D 214.
Kaufman, A. L. Franklin and Marshall (Lancaster). OM base. Röhmling, Pleasant.
Kehoe, Catharine E. grad. asst. zool. Oberlin. Br 218. Budington.
Kindred, J. E. assoc. prof. hist. and emb. Virginia. Br 106. D 311.
King, Jessie L. prof. phys. Goucher. Bot 4. A 305.
Kraatz, C. P. asst. zool. Cincinnati. Br 334. Dr.
Matthews, S. A. assoc. anat. Pennsylvania. OM 24. D 208.
McBride, T. F. instr. clin. dentistry. Rock 7. Elliott, Center.
Moment, G. B. instr. biol. Goucher. Br 217 J. Rogers. School.
Morgan, T. H. prof. biol. Calif. Inst. Tech. Br 320. Buzzards Bay.
O'Brien, Helen instr. res. med. Pennsylvania. Br 109 and 311. Young, West.
Paaske, Ellen A. sec. Cornell Med. (N. Y.). Br 317. Paine, West.
Robertson, Kathleen M. res. asst. exp. biol. Toronto. Br 107. H 6.
Shapiro, H. res. asst. phys. Princeton. Br 127.
Strong, O. S. prof. neur. Columbia. Bot 5. Elliot, Center.
Varrelman, F. A. res. biol. Vienna (Austria). L 34. Lyons, Main.
Wells, G. P. lect. zool. University College (London). D 217.
Wheeler, N. C. asst. phys. Purdue. Br 126. K 5.
Willier, B. H. prof. zool. Rochester. Br 324.

STUDENTS IN INVERTEBRATE ZOOLOGY

Allen, T. H. Iowa. K 7.
Babcock, Ruth H. teach. biol. Caldwell High. H 7.
Bader, Joan E. Montclair State Teach. W H.
Bishop, D. W. instr. zool. Pennsylvania. Dr 7.
Bonnet, D. D. Harvard. Dr 5.
Bowen, W. J. grad. biol. Hopkins. Hilton, Glendon.
Burlington, Mary grad biol. McGill. Grinnell, Bar Neck.
Bush, Aeleta N. grad. biol. Emory (Georgia). D 203.
Carson, H. L., Jr. Pennsylvania. Dr 14.
Cassidy, M. H. instr. biol. Hyde Park High (Mass.). Thatcher, (Falmouth).
Caylor, R. L. assoc. prof. biol. Delta State Teach. Dr.
Copeland, D. E. asst. biol. Amherst. K.
Cregan, Mary B. prof. biol. St. Xavier (Chicago). Goffin, Millfield.
Croasdale, Hannah T. res. asst. phys. Dartmouth Med. Sch. (asst. invert.). W G.
Dawson, R. W. asst. prof. zool. Minnesota. D 107.
Doyle, W. G. asst. zool. Oberlin. Dr.
Faben, Ann R. Goucher. H 9.
Farraday, C. L., Jr. Swarthmore. Dr 7.
Granger, Barbara S. asst. zool. Mount Holyoke. Young, West.
Grave, C., II. Washington. (St. Louis). Grave, High.
Grobstein, C. City Coll. New York. Ka 4.
Harris, W. A. De Pauw. Dr 2.
Hill, D. L. grad. chem. asst. Iowa. Ka.
Hogan, Stella M. prof. biol. St. Xavier (Chicago). Goffin, Millfield.
Hollaender, A. invest. rad. comm. N. R. C. Wisconsin. Br 114. Broderick, West.
Hoyt, J. S. Y. undergrad. instr. biol. Washington and Lee. Dr attic.
Huntington, Margaret O. Swarthmore. H 3.
Johnson, R. B. Connecticut State. Dr 8.
Kimball, R. F. grad. zool. Hopkins. Hilton, Glendon.
Knoth, Sibyl C. head science dept. Gulf Park College. W I.
Koster, R. grad. biol. Harvard. Ka 2.
Lewis, Wilma undergrad. asst. biol. State Teachers (Montclair). Cassidy, Millfield.
Morgan, Gwendolynn W. Sarah Lawrence. H 2.
Moyer, Elizabeth K. grad. asst. zool. Mount Holyoke. Young, West.
Norris, C. H. Hamilton. K 6.
Potts, H. E. grad. biol. New York. Swain, Millfield.
Ray, D. T. asst. prof. zool. Johnson C. Smith (N. C.). Dr.
Reed, Mary V. instr. science and math. Knox Sch. (Cooperstown, N. Y.). A 306.
Roxby, J. B., Jr. Wesleyan. K 6.
Sarin, L. Colby. Elliot, Center.
Seaton, Jane Penn. Col. for Women. H 8.
Sensenig, W. Haverford. D 316.

(Continued on page 136)

EMBRYOLOGISTS ♀  ♂ **SWAN SONG**

The game is over and the players gone. Yet we have to relate the last inning, the last desperate spurt of work by those who realized that they might never again enjoy these privileges, and the sad departure.

The lecturers of the week were Dr. Grave, Dr. Barth, and Dr. Holtfreter. Dr. Grave continued his work on annelids and molluscs, including in his "hetero" lecture of Tuesday a few words on the Recapitulation Theory as an element adding much to the interest of biology. Dr. Barth treated of the normal and experimental development of tunicates and ascidians. The material used in laboratory included Peneries (?), Styela, Ciona and Amaricium. Dr. Holtfreter reported experimental work done to make more clear the general organization of the embryo, using amphibian material for his illustration. One remark of Dr. Holtfreter, concerning his handicap in using the English language as his lecturing medium, ought to be repeated: "You will please excuse me if I am not easily understood, because I am a heteroplast transplantation into this country where you speak the English language."

Monday night Rev. Michael Fronczak of the embryology class presented a full length movie including several travelogues and pictures taken here at Woods Hole. In a previous program which he presented some three weeks earlier he showed two "Felix" crazy cartoons; but he disappointed the class in this respect at the second showing.

On Tuesday evening the class met in the laboratory at nine o'clock to study the spawning actions of Bennaria (?), an animal which spawns only at night. It was a busy night. The beasts were slow to "produce," and there was much time before the last person retired at three in the morning to discuss the class questionnaire. The questionnaire was an idea sponsored by the class for putting into statistical form the ideas concerning the material and arrangement of the course which would be valuable to those confronted with the problem of planning and revising it in the future. Blanks were distributed to the students and to the faculty by the class committee. The results will be given to Dr. Packard for the use of the laboratory.

Wednesday night the baseball team played a return game with the Collecting Crew, regaining the championship of the M. B. L. softball league (even without the expert pitching of Dr. Barth!). To the Invertebrates (really?) who inherit our laboratory, we pass the honors of defending this crown.

Came Thursday night, and the first travelers departed. Friday, Pearl Shykin packed up her Camera Club. Exchange of addresses (a touching scene) became a craze; snapshots, fishermen's caps, and tuxedo shirts (wups!) were autographed. The fortunate members of the class who did not break into tears . . . who are remaining, are: Katherine (Katrina) Hummel, Mabel (Syrup) Culberson, Margaret (Smitty) Hensen, Michael (Movies) Fronczak, and Harry (Lord Plushbottom) Lipman. These people will be busy, for periods varying from two weeks to the rest of the summer, at research problems.

DONALD BAUER

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.	Date	A. M.	P. M.
August 4	5:44	5:57	August 8	8:49	9:22
August 5	6:28	6:49	August 9	9:43	10:25
August 6	7:15	7:36	August 10	10:40	11:23
August 7	8:02	8:28	August 11	11:42	

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

Article entitled Election of Trustees transferred to page 5 of Supplement issued on Saturday, August 1.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

THE SCHOLARSHIP FUND ASSOCIATION

Although no formal constitution can be adopted until the middle of August, things have advanced so far and so satisfactorily that to all intents and purposes THE COLLECTING NET Scholarship Fund Association has hatched; in its infant state it welcomes members. We have set as our goal; not less than one hundred members by October 1, 1936; a membership list of two hundred by January 1, 1937 does not seem impossible of attainment.

In order that potential members may have clearly in mind how the money that they contribute is spent it seems appropriate to outline the salient points of the organization:

(1) The award is for the purpose of promoting original research work in the biological sciences, by giving financial assistance to promising *young* investigators.

(2) The annual membership fee is to be $5.00. For persons caring to make a larger contribution, other classes of memberships are provided. For example contributing and sustaining members are assessed $10.00 and $25.00 annually.

(3) THE COLLECTING NET has undertaken to pay the entire administrative costs of the organization so that the full membership fee in each case shall apply directly towards a scholarship.

(4) The scholarships, in general, will consist of a monetary award of $100.00.

(5) Applicants from cooperating institutions will be eligible for the award. A "cooperating institution" is here defined as one whose director serves upon the Board of Trustees or one which appoints an individual as its official representative on this Board.

(6) The candidate is to be chosen by the institution he is affiliated with; that is, the Scholarship Fund Association will assign scholarships to the directors of the marine laboratories and they in turn will be responsible for the selection of the "awardee" and for the purposeful use of the money assigned.

(7) Candidates must be "deserving students in the biological sciences." A combination of three attributes should prevail: research ability, need of additional funds and the intangible quality of being a welcome investigator at any summer laboratory.

(8) In order that these three points can be weighed with discernment only persons who have completed a summer's work at a given laboratory are eligible for the award of that institution.

(9) The summer following the award, an incumbent is expected to spend not less than eight weeks devoted to full time research work, preferably at one of the cooperating marine biological laboratories.

(10) Successful candidates at the time of their election shall prepare a note of not more than 500 words for publication in THE COLLECTING NET. This brief statement should outline their problems, its importance, and their plans for procedure.

(11) At the conclusion of the work carried out with the assistance of the award, the scholarship-holder is expected to prepare a statement of about 1,000 words to be published in THE COLLECTING NET which outlines the work done during his incumbency.

Every reader must at once realize that the above items are perforce tentative. When the organization is completed the trustees of the Association, through their Executive Committee, will have absolute power over the funds and the way in which they are spent. The following trustees have accepted appointment as members of the Executive Committee of the Board of Trustees, subject to ratification by the Board as a whole: Dr. C. E. McClung, *chairman*; Dr. Eric Ponder; and Dr. William H. Cole.

From The Mount Desert Island Biological Laboratory

Dear Mr. Cattell: July 29, 1936

Please forgive my delay in answering your two letters about THE COLLECTING NET Scholarship Fund. The laboratory will gladly grant free research space to individuals holding a scholarship from the fund, so that the hundred dollars can be used for board, room and traveling expenses.

It will be a pleasure to assist the Scholarship Fund Association by serving as a member of its executive committee. Since it will be impossible for me to come to Woods Hole this summer to attend any meetings, all my help must be through the mails. Please call me whenever you think I might be of service.

This laboratory is pleased to note that the Fund has made available one of the scholarships for a young man now in residence here. Our executive committee will recommend a candidate at the end of the season and notify you accordingly. I note that the $100. will be payable on or before June 15, 1937.

(*Signed*) WILLIAM H. COLE

ITEMS OF INTEREST

SEVENTH INTERNATIONAL CONGRESS OF GENETICS

An announcement has been received from the Organization Committee stating that the Congress of the Seventh International Congress of Genetics will be held during the second half of August, 1937, in Moscow.

Members of the Organization Committee are as follows: President: A. I. Muralov, president of the Lenin Academy of Sciences; Vice-presidents: N. I. Vavilov, vice-president of the Lenin Academy of Sciences, V. L. Komarov, vice-president of the Academy of Sciences; General Secretary: S. G. Levit; Other members: N. P. Gorbunov, G. D. Karpachenko, B. A. Keller, N. K. Koltzoff, T. D. Lysenko, G. K. Meister, H. J. Muller, M. S. Navashin, and A. S. Serebrovsky.

All those wishing to receive announcements about the Congress should send their names to the Organization Committee of the Seventh International Congress of Genetics, Institute of Genetics, Academy of Sciences, Bolshaya Kaluzhskaya 75, Moscow, U. S. S. R.

Under the guidance of Dr. E. Alfred Wolf, associate professor of biology at the University of Pittsburgh, a class in scientific German has been meeting on Monday, Tuesday, and Friday evenings at 6:45 in the old lecture hall. Dr. Wolf conducts the class by associating every new German word with an English or an old English parallel in order to make it easier to learn. A rapid survey of the fundamentals in German which are essential to reading is being made before starting the study of scientific words. By the end of the summer Dr. Wolf predicts that all these people who have had a little German before starting the course should be able to read scientific German very well.

The new x-ray equipment of the Marine Biological Laboratory was put into use last week after three weeks of intensive work in its construction. Mr. Barclay was in charge of the work of setting it up while Mr. Egeland was in charge of the apparatus itself.

To the melody of Freddie Josefek and his orchestra, The Collecting Net will hold a dance for its Scholarship Fund on Saturday, August 8, at the M. B. L. Clubhouse. Admission charge for M. B. L. Club members and subscribers to The Collecting Net is ten cents per person, for all others fifty cents. The entertainment committee promises several novelty dances and refreshments will be served.

Dr. Rudolph Höber, visiting professor of physiology at the University of Pennsylvania, Mrs. Höber and their daughter Ursula left Woods Hole on Thursday for New York. They will sail tomorrow on the SS. *Bremen* to spend the next two months visiting their family in Germany.

Dr. Sumner C. Brooks, professor of zoology at the University of California, was the victim of a heart attack last week at the bathing beach after a swim. He is recovering but is still confined to his room in the Brick Dormitory of the Marine Biological Laboratory.

Newcomers are being welcomed to Woods Hole at a *Mixer* to be held tonight at the M. B. L. Club house. Everyone is invited to attend. Mrs. Heinz Specht, social chairman, has appointed the following committee chairmen: Elisabeth Mast, social; Mrs. F. H. Figge, refreshments; Margaret Mast, posters; Mrs. P. B. Armstrong, invitations.

The noted brain surgeon, Dr. C. H. Frazier, died on July 26, in his sixty-sixth year. Since 1922, he had been the John Rhea Barton Professor of Surgery and Head of the Department of Surgery at the University of Pennsylvania. He was also a trustee of the University.

Dr. James Watt Mavor has just completed work at Woods Hole on his book entitled "General Biology," which will be published August 18 by the Macmillan Company. Dr. Mavor is professor and chairman, field of biology, Union College, Schenectady.

The M. B. L. Tennis Club tournament will be completed today. The teams for the semi-final doubles were Kidder and Summers vs. Ball and Rugh, and Armstrong and Goldin vs. Stunkard and Speidel. The contestants for the semi-final singles were Jenkins vs. Hollingsworth and Robertson vs. Speidel.

At Cornell University Medical College, New York City, announcement has been made of the appointment of Dr. Oskar Diethelm, of Johns Hopkins, as professor of psychiatry and director of the department, and Dr. Joseph Hinsey, of Stanford University, as professor of physiology and director of the department. Other changes include Dr. McKeen Cattell who becomes associate professor of pharmacology, and Dr. Dayton J. Edwards who has been made assistant Dean.

SPECIAL CLUB MEETING ON AUGUST TENTH

The Special Meeting called to consider the New Constitution of the M. B. L. Club will be held at seven on the evening of August tenth. It was erroneously announced for August three in "Entrée Edition" of The Collecting Net issued on Saturday, August 1.

ITEMS OF INTEREST

M. B. L. CLUB NOTES CONTRIBUTED BY ITS ENERGETIC SECRETARY-TREASURER-TO-BE

Special Notice: A meeting for the purpose of discussion and action on the proposed changes in the Constitution and By-Laws of the M. B. L. Club will be held in the Club house on Monday, August 10, at 7 p. m.

Plans are maturing for the second Mixer of the season, which will be held on Saturday evening the first of August. Arrangements are in the hands of the Social Committee under the chairmanship of Mrs. Specht. Attendance of all laboratory people is invited, especially the recently arrived students and newcomers to Woods Hole. There will be opportunity for everybody to meet everybody else and later in the evening there will be dancing. The Mixers are an important informal function which the Club performs for the community, and non-members are as welcome as members.

The question has been raised and widely discussed as to the advisability of hiring orchestras for the regular Saturday night dances. The matter was referred to the Executive Committee, and it was their opinion after listening to all sides that under the present financial circumstances phonograph music was preferable to orchestral music for the regular dances. However, it was decided to accept the offer of THE COLLECTING NET to organize an orchestra dance for Saturday the 8th of August.

The membership drive will be launched next week with fury and abandon. Reasons why you should be a member of the Club are: (1) Dues are only $1.50 (even less than that for students: $1 for the term of the course). (2) The Club house is the only congenial non-strenuous escape from the laboratory that is possible in Woods Hole, especially in foggy weather. This asset becomes incomparably more valuable after a couple of weeks of fog, which may blow in at any minute now. Read the magazines, sit in comfortable chairs, talk English rather than Biology, watch the boats go by. (3) The social life of Woods Hole, confined entirely to the Club house, is only open to members, except by special arrangement. Saturday night dances! Monday night concerts! Checkers, Bridge, Pingpong! Membership is open to laboratory people and their families on payment of dues, either to the main office of the Marine Biological Laboratory, to the Secretary-Treasurer (Ballard, 217H Br.) or to the doormen at the special dances and concerts.

Mr. and Mrs. Burridge Jennings will arrive in Woods Hole on August 5 for a stay of several weeks.

Introducing

DR. JOSEL SZEPSENWOL, fellow of the Rockefeller Foundation for Medical Research. Dr. Szepsenwol was born at Radoszkowice, Poland. He received his degree in science from the University of Toulouse in 1927 and matriculated at the University of Geneva Medical School in 1931, working under Professor A. Weber, professor of anatomy. He received the prize of the Medical School of Geneva University in 1936 for a paper on "Development of Nerves."

At the University of Geneva, Dr. Szepsenwol held the position of assistant in anatomy for two years and in 1931 became the chief of the anatomy laboratory. Coming to the United States last September as a Rockefeller Fellow, he has worked with Professor Ross G. Harrison at Yale University on experimental embryology in amphibians.

Dr. Szepsenwol has published some forty papers in the field of embryology. He has traveled in Italy and studied at the Naples biological station. In September he will return to his post in Geneva.

E. T.

Dr. Ellen Fitz Pendleton, until recently President of Wellesley College, died on July 26 at the age of 71 years. The new science building, housing the departments of chemistry, physics and psychology is named after her. Prior to her appointment as President of Wellesley, Dr. Pendleton was associate professor of mathematics at the College.

MISS LOLA T. JOHNSON (Radcliffe, 1935) has been appointed laboratory and secretarial assistant to Dr. Paul D. Lamson, chairman of the department of pharmacology at the Vanderbilt University School of Medicine. At the time of her appointment she was assisting with the editorial work of THE COLLECTING NET.

SUPPLEMENTARY DIRECTORY

(Continued from page 132)

Shelton, Meredith Sarah Lawrence. H 2.
Spratt, N. T. temp. instr. biol. Emory (Atlanta). K 4.
Stevenson, J. H. grad. asst. zool. Oberlin. K 7.
Stokes, Miriam asst. zool. Mount Holyoke. Young, West.
Stump, A. B. asst. zool. Virginia. Dr 6.
Swift, Katharine W. Smith. Swift, Gansett Pt.
Twichell, A. R. Wabash. Dr.
Waterman, T. H. Harvard. Ka 4.
Weierbach, Lily A. instr. biol. Simon Gratz High Sch. (Phila.). Young, West.
Weinberg, S. L. grad. biol. Columbia. Ka 3.
Weir, Ellen H. Wilson. W.
Wheeler, N. C. asst. phys. Purdue. K 5.
Wightman, J. C. grad. asst. biol. Brown. (Asst. Invert.). Dr 1.
Wood, Elizabeth C. grad. biol. Montclair State Teach. H 9.

DEPARTMENT OF PUBLICATIONS

A DISCUSSION OF THE DEVELOPMENT OF THE NERVOUS SYSTEMS

NEUROEMBRYOLOGY, AN EXPERIMENTAL STUDY, Detwiler, Samuel R., 213 pp. Illustrated. The Macmillan Company, New York. 1936. $3.75.

Dr. Detwiler's monograph deals with various problems in the experimental embryology of the nervous system. This has been one of the most fruitful fields in the experimental analysis of development. A large part of the book is devoted to the author's own extensive, carefully planned and beautifully executed researches, carried on over a period of approximately twenty years.

The first chapters are rather brief. There is a short historical sketch of the history of the neurone concept, chiefly concerned with the embryological origin of the nerve fiber; a chapter, equally brief, on the development of the technique of embryonic transplantation; and an account of the relation of neuroblast and sheath cell in the development of the peripheral nerves.

The other topics are in general dealt with in greater detail. There is an excellent discussion of the author's experiments in changing the direction of growth of peripheral nerves following various types of embryonic transplantations. These have been very suggestive for an analysis of some of the factors governing the direction of growth of nerves. Further light on this subject has been given by the classical experiments of Harrison on the growth of nerves in tissue culture, and the more recent work of Weiss. The bearing of these different lines of approach on a possible explanation of the orientation of the normally growing nerve fiber is discussed.

A considerable section of the book is concerned with the general problem of cellular proliferation within the spinal cord and the spinal ganglia: Thus the relation between the extent of the peripheral field to the proliferation of sensory neurones on the one hand, and motor neurones on the other (Detwiler's own work). The discussion of factors within the cord and brain stem affecting motor proliferation in the cord follows and is related to the work of Burr and others on the effect of the ingrowth of peripheral nerve fibers on the central nervous system. There is finally an interesting discussion on the relation of mesodermal metamery to the segmentation of the cord. The original work of Lehmann on this subject has been recently modified and greatly extended by the author.

Certain other problems are taken up, but perhaps the above will give the reader some idea of what he may find in this monograph. The book is amply documented. There is a bibliography of about 270 titles. As mentioned in the preface, the work on the earliest stages of nervous development, namely the relation of the neural plate to the dorsal lip of the blastopore, as worked out by Spemann and his associates, is left out. This seems an unfortunate omission in a book aiming at a synthesis of the present state of the subject. Nevertheless, the material included is covered in an admirably clear fashion, and the book should be of great interest and a source of stimulation to all interested in biological problems.

Oscar E. Schotté

FORTHCOMING ARTICLES IN OTHER JOURNALS

"THE JOURNAL OF EXPERIMENTAL BIOLOGY" (August)

McGowan, J. P., Suprarenal **Virilism** in a Domestic Hen, Its Possible Significance.

Marshall, F. H. A. and Bowden, F. P., The Further Effects of Irradiation on the Oestrous Cycle of the Ferret.

Picken, L. E. R., A Note on the Mechanism of Salt and Water Balance in the Heterotrichous Ciliate, **Spirostomum Ambiguum.**

Jacoby, Fritz, The Growth and Morphology of Fibro-Blasts **in vitro** in Relation to Certain Properties of the Plasma Coagulum.

Francis, Eric T. B. and Horton, Frances M., Some Reactions of the Ammocoete.

Löwenstein, Otto and Sand, A., The Activity of the Horizontal Semi-Circular Canal of the Dogfish, **Scyllium Canicula.**

Le Mare, D. W., Reflex and Rythmical Movements in the Dogfish.

Eastham, L. E. S., The Rhythmical Movements of the Gills of Nymphal **Leptophlebia Marginata** (Ephemer-Optera) and the Currents Produced by Them in Water.

Gunn, Donald L. and Kennedy, John S., Apparatus for Investigating the Reactions of Land Arthropods to Humidity.

Wykes, Ursula, Observations on Pigmentary Co-ordination in Elasmobranchs.

Johnson, M. L., The Control of Respiratory Movements in Crustacea by Oxygen and Carbon Dioxide. II.

Harris, J. E., The Rôle of the Fins in the Equilibrium of the Swimming Fish.
I. Wind-tunnel tests on a model of **Mustelus Canis** (Mitchill).

"THE QUARTERLY REVIEW OF BIOLOGY" (September)

Schultz, Adolph H., Characters Common to Higher Primates and Characters Specific for Man.

Adelmann, Howard B., The Problem of Cyclopia, Part II.

Brues, Charles T., Aberrant Feeding Behavior Among Insects and its Bearing on the Development of Specialized Food Habits.

Gause, G. F., The Principles of Biocoenology.

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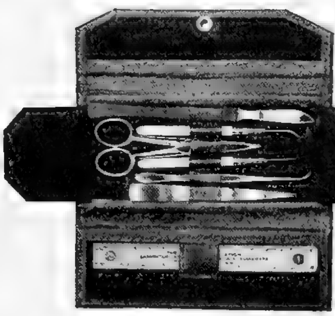

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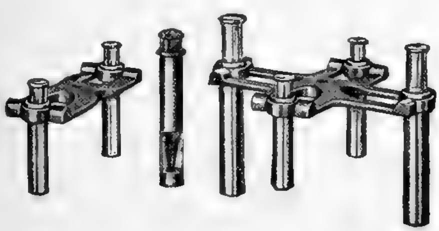

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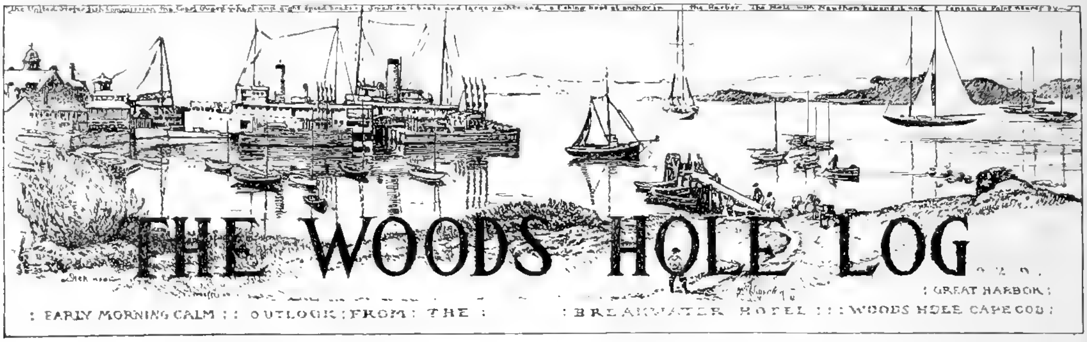

CRITICIZING A CRITIC

As I was walking down Main Street a few days ago I noticed a gentleman approaching me who, at a distance appeared quite put out about something and at closer perusal seemed disturbed yet amused—if such a thing is possible. This man possessed an Irvin S. Cobb countenance that was made more profound by a voice that seemed to shake the very ground we stood on. He opened the cavernous gap that was his mouth and from it, midst a jumble of inarticulate sounds, emerged the following:

"Young man, your article in this week's issue of the *Woods Hole Log*, which you so inappropriately entitled 'Indolence?' was without a doubt the most atrocious and disgusting piece of literature I have ever read. Had it possessed the five canons that Edgar Allan Poe set down as essential in writing the short story, I would venture to say that it was the most ridiculous, yet amusing, *short story* ever written. What ever made you think that you had the authority to write such a thing? What have you against the people in the town that you were brought up in? However, time it might be, do you not think that it is the place of some person who has done something for the town to write such an article, not a young upstart who knows nothing about what he is talking? The people in Woods Hole have always treated me fairly and squarely and I have been around a lot longer than you have. I think that you should apologize to every person in the town —in fact, I demand it."

He was then interrupted by a friend, to whom I am thankful, and he left by saying, "Think that over young man."

After meditating on this marvelous oration I came to the conclusion that I owed no one an apology but that I would try to make things more vivid for those who are of the same opinion as the gentleman mentioned—but who, unlike him, whispered their opinions among themselves. Incidentally, my most esteemed critic was talking so fast that I could not get a word in. — I believe that there is not much more in the way of criticism that could be added to my critic's speech so I will clarify the situation by remarking upon each of his accusations or criticism—in order.

He said that my article was atrocious and disgusting. Possibly he was right. Even the truth at times can be repulsive and very bad. He then stated that had the article possessed the five canons of Poe that are essential to the short story he would venture to say that it was the most ridiculous yet amusing short story ever written. My most honorable critic, do you not know that the canons of Poe are seven in number, not five?

I do not think that the question of authority can be brought up when discussing whether or not I should write in such a vein; unless the gentleman is not an advocate of free speech. I will say, however, that a young person who has not had an opportunity to help the town in any way is at more of an advantage to write or talk about such things than a person who has done something because there is not that tendency present to be prejudiced. As for asking me what I had against the people—only a person with a child's mind and a very provincial attitude would ask such a question. After all, all that was said was: Why is there not more interest on the part of Woods Hole people when there is room for their interest and aid?

F. E. McInnis

The fatal attack on sixteen-year-old Joseph C. Troy, Jr., by a shark at Mattapoisett last Saturday has its repercussions in Woods Hole. Mr. Robert T. Goffin, superintendent of the United States Bureau of Fisheries, has been besieged with telephone calls from summer residents and reporters on the subject of sharks. Bathers seem to be more cautious and conversation on the beaches includes discussion on sharks.

On Sunday, August 2, there will be two speakers at the Forum to be held at Dr. J. P. Warbasse's home on Penzance Point. Mr. Gardner Jackson of Washington, D. C., will speak on governmental control and administration of industry and service. Dr. Warbasse will speak on the voluntary cooperative administration of industry and service.

(More Local News on page 142)

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THE WOODS HOLE LOG

THE WEEK IN BOATING

The thirteenth annual regatta of the Edgartown Yacht Club, Martha's Vineyard, was held last weekend. On Thursday evening July 23, the Southern Massachusetts Yacht Racing Association had a dinner and meeting at the Harbor View Hotel. A buffet supper and dancing were provided for visitors at the Bathing Pavilion. The racing events which included the "S," "Wianno," "CC," and the "BB" classes were postponed from Friday to Saturday because of the heavy rain. Over one hundred and ninety sailing craft took part. Two dances were held at the Yacht Club, the Annual Regatta dance Friday night and the regular weekly dance Saturday night.

On Sunday water sports, short and long swimming races and a diving competition were open to members of invited yacht clubs and their guests.

The *Constance* belonging to Mr. Seward Prosser of Penzance Point took first place in the schooner class at the regatta. Although sailing her first race in many years, she covered the distance of twenty-two miles in two hours and forty-seven minutes.

The *Algonquin,* coast guard boat stationed at Woods Hole, took the Secretary of the Treasury, Henry Morgenthau, Jr. and a party of ten for a three day cruise to the Edgartown regatta.

In the Woods Hole Yacht Club races Monday the boats taking first place were the *Bellina* under Anita Luscumbe in the "W" class, the *Mac W'in* under Sam Cahoon in the "CC," the *Bandit* under Mary Draper in the "BB," and the *Sea Goon* under Lilly Claire Faust in the "SC."

EVENING CONCERT

The Methodist Episcopal Church held its annual concert last Thursday night in the Marine Biological Laboratory auditorium. Miss Catherine Carver, who was to have played the piano accompaniment, replaced Richard Warbasse, violinst, as the instrumental soloist on the program.

James R. Houghton, baritone, opened the concert with the scheduled numbers, ending the first part with Moussorgsky's ever-amusing "Song of the Flea." Miss Carver played "A Sigh" by Liszt and "Prelude in G Major" by Rachmaninoff. Mr. Houghton sang three Schubert selections among them the "Serenade" in place of the scheduled Verdi aria; by request he gave three numbers, among them "I Love Life" and "Floral Dance." Miss Carver included in the next group two Spanish numbers and Mr. Houghton gave the last group, substituting the rousing negro spiritual "Glory Road" for the final number.

The program was impromptu for the most part, Mr. Warbasse being unable to play because of a sprained back.

In response to a fire alarm last Monday the two Woods Hole fire engines rushed to the very small cottage of Mrs. Mabel Hilton (Mother of "Doc" Hilton, collector for the Supply Department of the Marine Biological Laboratory). Several garden hoses were playing water on the flames when they arrived. Prompt work with extinguishers, a large hose, and hatchets put out the fire, but not before the flames had destroyed all furniture and personal articles. In addition windows were broken and shingles shoveled from the roof, so that the whole cottage was practically a loss. The fire started after Mrs. Hilton, a lady of about sixty years, started cooking lunch on the oil stove and went out into the yard. When she looked around a short time later flames were creeping up the walls. An alarm was given and Mrs. Hilton, who was badly frightened, was taken into her son's home.

An eight foot blue shark and a torpedo ray were brought in by the Bureau of Fisheries collecting boat last week. The shark, which is of the variety that does not live in captivity, died almost immediately; Dr. Edwin Linton, authority on fish parasites, extracted many parasites from the shark's stomach.

(Photograph from Boston Herald)

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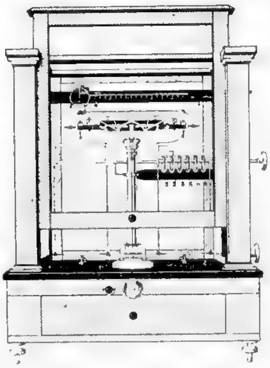

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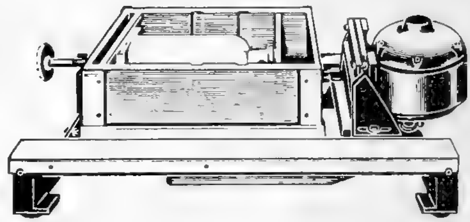

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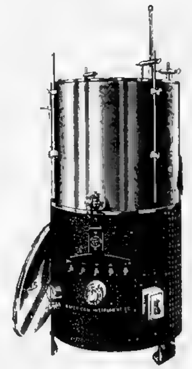

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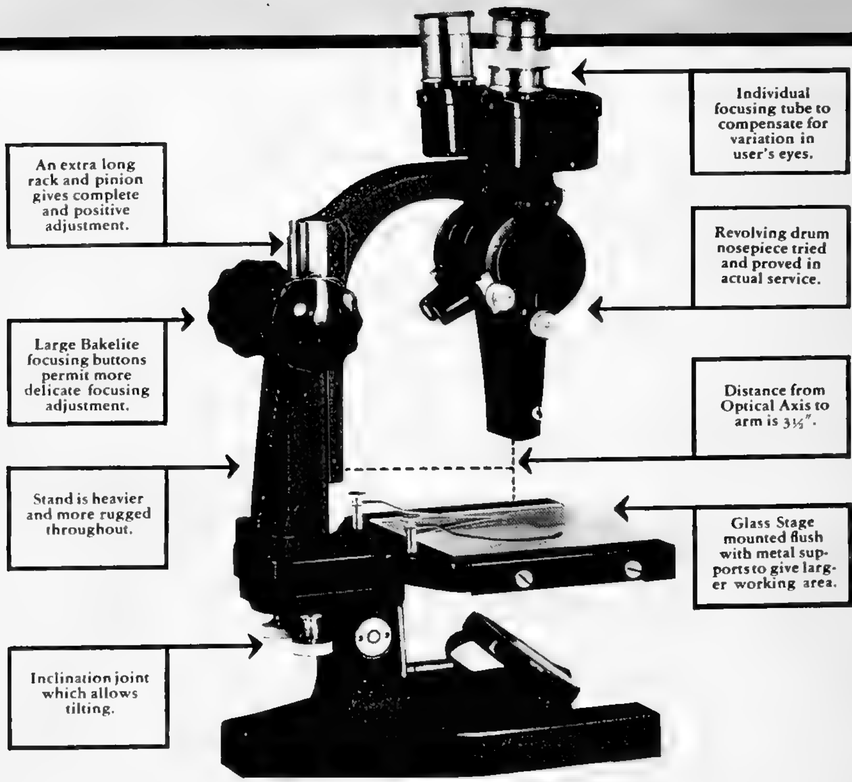

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Woods Hole, Mass.,
July 3, 1936.

At the meeting of the Corporation held August 11, 1931, it was voted that "On or about the first of July of each year, the Clerk shall send a circular letter to each member of the Corporation, giving the name of the Nominating Committee", (for considering the names of candidates for election as officers and Trustees), "and stating that the Committee desires suggestions regarding nominations."

Officers and Trustees are elected by the Corporation; members of the Corporation are elected only by the Trustees. The new officers—viz. Treasurer and the Clerk of the Corporation, are elected annually,—Trustees are elected for a term of four years. The present officers and Trustees of the Class of 1936, all of whom, except M. J. Greenman, may be re-elected, are as follows:

Treasurer of the Corporation .... Lawrason Riggs, Jr.

Clerk of the Corporation .... Charles Packard

8 Trustees of the Class of 1936

H. B. Bigelow
R. Chambers
W. E. Garrey
Caswell Grave
M. J. Greenman
C. E. McClung
A. P. Mathews
C. R. Stockard

Any member who wishes to suggest names to be considered by the Nominating Committee should send them to the Chairman before August 1, 1936.

C. E. McClung, Chairman
G. N. Calkins
Charles Packard
P. B. Armstrong
W. S. Root

Charles Packard, Clerk

Suggestions for the Nominating Committee 1936
N. B. Nominees must be members of the Corporation.

For Treasurer .... For Clerk ....
For Trustees of the Class of 1940

....

....

....

....

Signature ....

Note: Dr. Greenman is eligible for election only as Trustee Emeritus.

THE COLLECTING NET

Entrée SATURDAY, AUGUST 1, 1936 Annual Subscription, $2.00 Single Copies, 30 Cents.

COME TO THE MIXER AT THE CLUB TONIGHT!

The second mixer of the season will be held by the Marine Biological Laboratory Club this evening, beginning at eight o'clock. Every member of the scientific community—together with their friends—are cordially invited to attend the affair by the officers of the Club. Refreshments will be served; the "amplifier dance" will begin as soon as the bed-time hour of the trustees and members of the corporation approaches. There will be no admission charge of any kind during the evening, and everyone who comes will enjoy meeting people, drinking fruit punch, and the dancing afterwards. The latter will probably begin soon after ten o'clock, but the exact time will be set by the mood of the crowd. Mrs. Louise Mast Specht is Chairman of the Social Committee; this fact alone is assurance that the evening will be a delightful one for all those who come to the Club to-night. Miss Elizabeth Mast, a sister of Mrs. Specht, is in charge of introducing people to each other.

EDITORIAL ANNOUNCEMENT

This four page folder will serve as a vehicle for several things of *current* interest which would lose in value by not being issued before the fifthcoming issue of The Collecting Net which will not be ready for distribution until Monday or Tuesday.

M. B. L. Club Calendar

SATURDAY EVENING, Aug. 1
Mixer: Everyone welcome; refreshments and dancing: at the M. B. L. Club House.

MONDAY, August 3, 7:00 P. M.
Special meeting of the members of the M. B. L. Club to consider the proposed constitution.

MONDAY, August 3, 7:00 P. M.
Music Hour at the M. B. L. Club. 8:00 P. M. This may be delayed a few minutes owing to the special meeting.

NOMINATION OF TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY

On Wednesday, July 29, the nominating committee of the corporation posted its slate of eight members of the corporation for the 1940 class of the Board of Trustees to replace those retiring on August 11. A member of the corporation has caught up the Nominating Committee on a technicality, claiming that it came to a decision too soon; that is, that it met and posted its decisions before many of the suggestions, requested by the committee itself, had been received for consideration. The chairman is reported to believe that its committee's decisions were in accordance with the wishes of the corporation as a whole, that it had sufficiently considered every eligible individual, and that it would not be worthwhile for the group of five to reconvene to consider any further suggestions from Corporation members. He pointed out the opportunity that every member will have of nominating a candidate from "the floor." The meeting of the Corporation is to convene on Tuesday, August 11.

TABLE OF CONTENTS OF THE COLLECTING NET FOR AUGUST 1, 1936

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

NOMINATIONS FOR TRUSTEES OF THE CORPORATION

To every member of the Corporation of the Marine Biological Laboratory we should like to emphasize the importance of filling out the blank sheet which is included in this "appetizer" of the forthcoming issue of THE COLLECTING NET. Providing the chairman of the Nominating Committee is willing to accept such nominations at this time, they should be promptly given to him; if the Nominating Committee is of the opinion that its duties ended on Wednesday, July 29, THE COLLECTING NET will undertake to place the blanks in the hands of a committee which will not only tabulate the results, but also make the appropriate nominations from the floor at the Corporation meeting on August 11. This will, of course, not be necessary if, as the Nominating Committee must anticipate, the incoming blanks agree with the slate posted by it.

From The Mount Desert Island Biological Laboratory

Dear Mr. Cattell: July 29, 1936

Please forgive my delay in answering your two letters about THE COLLECTING NET Scholarship Fund. The laboratory will gladly grant free research space to individuals holding a scholarship from the fund, so that the hundred dollars can be used for board, room and traveling expenses.

It will be a pleasure to assist the Scholarship Fund Association by serving as a member of its executive committee. Since it will be impossible for me to come to Woods Hole this summer to attend any meetings, all my help must be through the mails. Please call me whenever you think I might be of service.

This laboratory is pleased to note that the Fund has made available one of the scholarships for a young man now in residence here. Our executive committee will recommend a candidate at the end of the season and notify you accordingly. I note that the $100. will be payable on or before June 15, 1937.

(*Signed*) WILLIAM H. COLE

Concerning "The Collecting Net" Scholarships

TO THE EDITOR: July 31, 1936

THE COLLECTING NET Scholarships have assisted a number of students in the physiology course to continue their scientific work. It often happens that the possibilities of utilizing marine biological material are new to the student and that practical difficulties particularly hamper the student's application to summer work. The help of the scholarships is very important and the present positions of the past recipients prove that the students have made good use of their resources. Their names make an excellent list of able and energetic younger physiologists, and I think that we should use our sincere efforts to continue the line by aiding the scholarship fund.

LAWRENCE IRVING

The Elapse of Negative Time

TO THE EDITOR: July 26, 1936

I recently wrote the following letter about the *Nominating Committee*:

To the President of the Corporation,
The Marine Biological Laboratory,
Woods Hole, Massachusetts.

Sir:—

Under the date of July 3 a "circular letter" was addressed to members of the Corporation of the Marine Biological Laboratory stating that the nominating "committee desires suggestions regarding nominations." On July 29 the official slate of officers and trustees was posted on the several bulletin boards of the laboratory. The Clerk of the Corporation in his letter sets July 31 as the day upon which the last suggestions for Officers and Trustees must be made by its members.

In view of these circumstances, and as a member of the Corporation in good standing, I request

(1) That the notices of the decision of the Nominating Committee be withdrawn from the bulletin boards.

(2) That the Committee reconvene on or after August 1 to give its considered opinion upon the names of all officers and trustees suggested by members of the Corporation.

Furthermore, it would be courteous to extend the time limit from July 31 to a later date in order that members of the Corporation, who have suggestions to make and who have been prevented from filling out the blanks by the premature posting of the decisions of the Nominating Committee, be given the opportunity to submit their suggestions for consideration.

I shall appreciate a prompt reply to this letter because I wish assurance that if I fill out the blank that my suggestions will be considered by the Nominating Committee.

Very truly yours,

(*I signed my name here*)

Member of the Corporation of
the Marine Biological Laboratory

I submit the above communication for publication in THE COLLECTING NET because I think it may be of interest to your readers.

ANONYMOUS

M. B. L. CLUB NOTES CONTRIBUTED BY ITS ENERGETIC SECRETARY-TREASURER-TO-BE

Special Notice: A meeting for the purpose of discussion and action on the proposed changes in the Constitution and By-Laws of the M. B. L. Club will be held in the Club house on Monday, August 10, at 7 p. m.

Plans are maturing for the second Mixer of the season, which will be held on Saturday evening the first of August. Arrangements are in the hands of the Social Committee under the chairmanship of Mrs. Specht. Attendance of all laboratory people is invited, especially the recently arrived students and newcomers to Woods Hole. There will be opportunity for everybody to meet everybody else and later in the evening there will be dancing. The Mixers are an important informal function which the Club performs for the community, and non-members are as welcome as members.

The question has been raised and widely discussed as to the advisability of hiring orchestras for the regular Saturday night dances. The matter was referred to the Executive Committee, and it was their opinion after listening to all sides that under the present financial circumstances phonograph music was preferable to orchestral music for the regular dances. However, it was decided to accept the offer of The Collecting Net to organize an orchestra dance for Saturday the 8th of August.

The membership drive will be launched next week with fury and abandon. Reasons why you should be a member of the Club are: (1) Dues are only $1.50 (even less than that for students: $1 for the term of the course). (2) The Club house is the only congenial non-strenuous escape from the laboratory that is possible in Woods Hole, especially in foggy weather. This asset becomes incomparably more valuable after a couple of weeks of fog, which may blow in at any minute now. Read the magazines, sit in comfortable chairs, talk English rather than Biology, watch the boats go by. (3) The social life of Woods Hole, confined entirely to the Club house, is only open to members, except by special arrangement. Saturday night dances! Monday night concerts! Checkers, Bridge, Pingpong! Membership is open to laboratory people and their families on payment of dues, either to the main office of the Marine Biological Laboratory, to the Secretary-Treasurer (Ballard, 217H Br.) or to the doormen at the special dances and concerts.

CONSTITUTION OF THE MARINE BIOLOGICAL LABORATORY CLUB[1]

Article I. *Name.*

The name of the Club shall be the Marine Biological Laboratory Club.

Article II. *Object.*

The object of the Club is to promote social intercourse among the scientific workers of the Woods Hole community and their friends.

Article III. *Membership.*

The membership of the Club shall consist of two classes—Active and Associate. The scientific workers of the Woods Hole community and members of their families, 18 years of age or over, are eligible to active membership, and become members on payment of the annual dues. Other persons who are 18 years of age or over may be elected to associate membership as provided in the By-Laws.

Only active members in good standing have the right to vote. With the exception of voting, the associate members have all the rights and privileges accorded to active members.

The families of members are entitled to use the Clubhouse under the same conditions as members, provided that this privilege is not extended to any person less than 18 years of age.

Article IV. *Officers.*

The officers of the Club shall be the President, Vice-president, and Secretary-Treasurer. Only those active members who are in full standing and who are also members of the Corporation of the Marine Biological Laboratory shall be eligible to these offices.

The officers shall be elected at the annual meeting. They shall be subject to recall as provided by Article VII. Vacancies occuring at other times shall be filled as provided in Section I of the By-Laws.

Article V. *Trustees.*

There shall be a Board of Trustees of 6 members, one to be elected at the annual meeting each year and similarly, one to be appointed by the Director of the Marine Biological Laboratory. Each member shall serve for three years, excepting that on constituting the Board there shall be a class of two, elected and appointed as prescribed, to serve for one year, and another to serve for two years.

[1] The sections set in italics are those which are likely to come up for discussion at the meeting on Monday.

In addition to these three classes of Trustees, the President of the Club, if not already a Trustee; shall be a Trustee ex-officio.

ARTICLE VI. *Annual Meeting.*

The annual meeting of the Club shall be held each year on the third Monday in July, at which meeting the election of officers and trustees, the presentation of official and standing committee reports, and other stated business shall be transacted.

ARTICLE VII. *Special Meetings.*

Special meetings of the Club for any purpose except that of amending the Constitution may be called at any time by any officer of the Club; they may also be called by petition by at least 15 active members who are in full standing; the purpose and date of such meeting shall be stated in a notice which shall be posted on the official Laboratory bulletin boards and in the Club house, at least five days before the proposed date of such meeting.

ARTICLE VIII. *Amendments.*

Amendments to this Constitution can be made by a two-thirds vote of those active members who are present at any meeting, provided that at least thirty such members are present, or provided that one-third of the total active membership below 90 is present, and provided that the proposed Amendment and the petition for the meeting to consider such Amendment or Amendments and the date of such meeting shall have been signed by at least 10 voting members and posted on the official Laboratory bulletin boards and in the Club house at least 10 days before the date of the meeting.

ARTICLE IX. *Executive Committee.*

There shall be an Executive Committee of which the officers of the Club shall be *ex-officio* members. Other members of this Committee shall be appointed by the President to serve for one year, subject to discharge by him at any time.

BY-LAWS

I. The Executive Committee shall consist of nine members, and shall include the officers of the Club and the Chairman of the House and Social Committee.

The duties of this Committee shall be to attend to such general affairs of the Club as the running of the Club house and the appointment and discharge of a House Committee, a Social Committee, a Membership Committee, and such special Committees as it may deem necessary.

The Committee shall also have the power to fill vacancies in the offices of the Club occuring at other times than at the election at the annual meeting. The Committee shall further have the power to elect those persons to associate membership who do not, *ipso facto,* become members by the payment of dues, as provided in Article III of the Constitution, but who have been proposed and seconded by active members of the Club who are not members of the Executive Committee. The Committee shall, further, have power to decide all doubtful cases of eligibility.

II. A quorum of the Executive Committee shall consist of a majority of its members.

III. The Executive Committee shall meet at least twice monthly during the months of June, July, and August. The Trustees shall meet on the day following the annual meeting. *The Trustees shall act in a general advisory capacity to the Executive Committee, and shall have complete charge of all financial matters of the Club except in so far as this power may be delegated to the Secretary-Treasurer.*

The Secretary-Treasurer shall report monthly during June, July, and August, and once during the winter to a Trustee designated by the Board of Trustees.

IV. The Executive Committee shall appoint an Assistant Secretary-Treasurer who shall be a *resident* of Woods Hole. *His* function shall be to collect dues from members and to perform such other duties as may be delegated by the Secretary-Treasurer.

V. The Executive Committee shall, not later than the second Monday in July, each year appoint a Nominating Committee to nominate a slate of Officers and Trustees. This shall not preclude further nominations from the floor at the annual meeting.

VI. *In the event that an elected Trustee resigns before his term of office expires, the Club at a meeting called for the purpose, shall elect a Trustee to serve for the balance of the term. Similarly, the Director of the Laboratory shall fill by appointment, the place left vacant by the resignation of an appointed Trustee.*

VII. The dues for active members shall be $1.50 per year, except in the case of fully accredited students in the courses of the Marine Biological Laboratory, for whom there shall be an optional rate of $1.00; it being understood that this covers membership only for the duration of the course in which they are registered.

The dues for associate members shall be $3.00.

The Executive Committee shall have the right to assess additional fees should they be deemed necessary.

VIII. *These By-Laws may be altered by a majority of the Executive Committee, a majority of the Trustees concurring.*

THE COLLECTING NET

Vol. XI, No. 6 | SATURDAY, AUGUST 8, 1936 | Annual Subscription, $2.00 Single Copies, 30 Cents.

OPEN OCEAN AND COASTAL SHARKS: DO THEY ATTACK MEN?

Dr. E. W. Gudger

Associate Curator of Fishes, American Museum of Natural History

This question of perennial interest is raised nearly every summer by the accounts of alleged threatened attacks of sharks on bathers in our Atlantic coastal waters. To the public generally, and particularly to newspaper correspondents and reporters, every shark seen near a bathing beach or caught by sportsman and fisherman along our coast is a man-eater. Practically all such allegations have no foundation; and practically all of the sharks seen and caught are not man-eaters.

However, under date of July 25, 1936, a report came from New Bedford, Mass., that a boy in swimming near there had had his leg so mangled by a shark that he died shortly thereafter from shock and loss of blood. This attack and the subsequent events (the hunt for the shark, etc.) described by New Bedford and Woods Hole men who know sharks, have been written up in such detail in the Massachusetts and Rhode Island daily papers, and the facts are so well (*Continued on page* 156)

M. B. L. Calendar

TUESDAY, August 11, 8:00 P. M.

Seminar: Dr. Laura J. Nahm: "A study of the cells of the adrenal gland of the ewe during estrus and pregnancy."

Dr. E. A. Wolf and Grace Riethmiller: "Studies in calcification: III. The shell of the hen's egg."

Dr. Alexander Sandow: "Diffraction patterns of striated muscle and sarcomere behavior during contraction."

Dr. F. H. J. Figge: "The effect of some oxidation-reduction indicator dyes on the eyes and pigmentation of normal and hypophysectomized amphibians."

Dr. Robert Chambers: "The elimination of neutral red by the kidney tubules."

FRIDAY, August 14, 8:00 P. M.

Lecture: Professor H. W. Stunkard: "Life cycles of digenetic trematodes."

LANTERN SLIDES FOR ILLUSTRATING LECTURES

Dr. W. E. Forsythe

Physicist, Lamp Development Laboratory, General Electric Company

There is probably no more satisfactory method for showing extensive results of experimental work to an audience or for illustrating a lecture than the use of lantern slides. However, if slides are used, they should be so shown that they can be seen by the entire audience, and this includes that part of the audience that is the farthest from the screen. The slides should be so made that they illustrate and show just what they are intended to show. Many times a lecturer has to apologize for his slides, giving some of the many excuses for showing poor pictures. Some projected pictures are poor due to the carelessness of the maker of the slides; some are poor because the person making the slides did not know how to make them; and finally, others are poor due to the character of the projecting apparatus and screen.

The American Society of Mechanical Engineers has published a report[1] on Engineering and Scientific Charts for Lantern Slides which gives

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AIRPLANE VIEW OF WOODS HOLE

Juniper Point, the Buoy Yard, and Little Harbor in immediate foreground. Biological Laboratories in center of upper right corner.

some suggested practices for the design of charts for lantern slides. These recommendations, if followed, would effect a great improvement in the appearance of many of the projected pictures shown at technical meetings.

From the appearance of many slides shown at various technical meetings it must be assumed that, in general, the lecturer has neither read these recommendations nor tried out his slides beforehand. In the use of slides the same rule should hold as in any other portion of the lecture; that is, keep the interest of the audience and disturb them as little as possible. There are two sides to this problem; one the projection apparatus and the other the slides themselves. Sometimes a lecturer prepares good slides and then finds that adequate facilities are not available for showing them. Why anyone should invite a lecturer and an audience and then not do everything possible to make the lecture a success is difficult to understand. Everything possible should be done to help the lecturer get his story across and this should include the removal of disturbing elements.

While projection apparatus and the operation of such equipment may be criticized, the fact remains that for clear pictures good slides must be provided. The projected picture can be no better than the image on the slide and if this is too small or poorly made, poor pictures will result. If there is too much material, either lettering, curves, or pictures, on one slide, nothing can be satisfactorily shown.

If written material is to be shown, the letters should be of such size that when projected on the screen they can be easily read by anyone in the audience and this applies, too, to the person who is farthest from the screen. Letters properly typed with an ordinary typewriter and photographed make a good appearance when projected. One method of making the copy for such a slide is to use a good black ribbon with a white paper and to have this paper backed up with a good black carbon paper turned with the carbon side toward the sheet, so that the typed letters on the front of the paper are backed up by the carbon impression on the back. Since original typewriting often lacks blackness and breadth of the lines which comprise the details of a letter, a good carbon copy may be better than the original. An excellent carbon copy can be made on a heavy sheet of white paper upon which is superimposed a carbon sheet and a thin sheet of paper. By removing the typewriter ribbon the type hits the thin paper and makes the carbon copy on the heavy sheet. An additional refinement of carbon copies can be made by using two sheets of thin paper. A carbon sheet is placed in contact with the lower side of the second sheet in addition to the carbon paper placed in contact on the upper side, as is commonly done. In this way the carbon copy is made as usual, but it is backed up on its lower side by another carbon copy. In other words, this carbon copy has carbon imprint on both sides and the letters are now absolutely opaque and any irregularities in the blackness of the upper carbon copy are, in general, reduced by the black letters on the back; high contrast and perfection of letters are insured. These are excellent ways of making tables from which lantern slides are to be made. Such a copy can be photographed so as to make a good slide. Either the large or small letters may be used but if larger type is desired, the capital letters only may be used.

It has been found that if a sentence across a slide that is to be projected onto an ordinary screen about 8 or 10 feet wide is made up of about 50 letters, a very satisfactory projection is obtained for a lecture room of the size used for ordinary technical meetings. Much larger letters are not necessary and smaller ones give projected images that are very hard to read. A good rule is to keep the number of letters within this limit if possible and never show a slide that has more than a seventy letter sentence across it. For lettering on curves or pictures, some of the work at times requires larger and bolder letters than can be obtained with a typewriter.

Mathematical developments which are difficult to picture clearly can be shown by a slide made as described above. Again the lettering, figures, etc. should not be too small. The rule of having all letters of at least such size that a 50 letter sentence reaches the full length of the slides gives very satisfactory projection. It is well to have the lettering larger than the minimum desirable since this insures against the condition sometimes met when the projected pictures are too small. Lettering for photographic reproduction should be rather heavy. Thin lines are often lost. The maximum dimensions of a letter should be at

[1] November, 1932, Z15, 1-1932. See also **J. Soc. Motion Picture Engineers**, V23, P. 247, 1934.

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

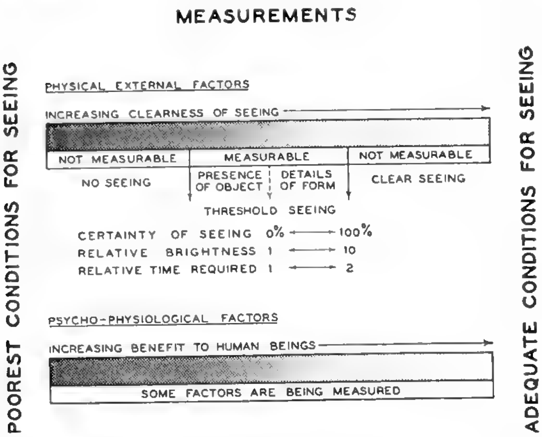


Fig. 1. A good example of lettering for a slide chart. Also an illustration of special shadings. From work of Luckiesh and Moss.

least one-fiftieth of the maximum dimension of the drawing from which a lantern slide is to be made.

Unless a person is very skilful he should not attempt to make a copy for a slide by using free-hand lettering. Ordinary handwriting should not be used in making copy for a slide since script does not make a good appearance when projected. To letter directly on the slide or to draw a picture on the slide is unsatisfactory as the appearance of the projected picture or lettering is apt to be very bad. One must be very skilful indeed to get a picture on the screen in this manner that is worth showing. Figures 1 and 2 show good examples of lettering for slides.

The use of lettering guide[2] makes it possible

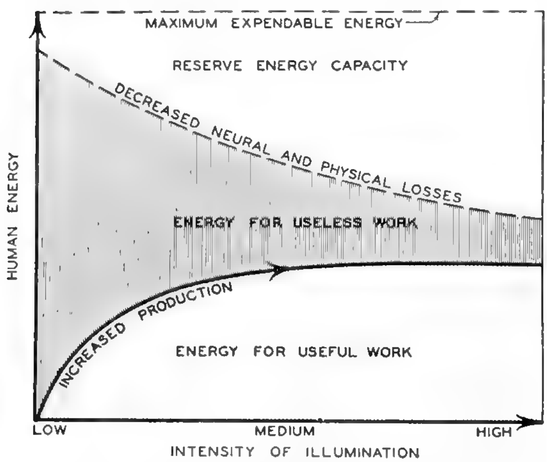


Fig. 2. A slide chart that very well illustrates a good method of lettering, shading, and curves. Taken from work of Luckiesh and Moss.

for even an inexperienced person to do excellent lettering at a fairly rapid rate. The legibility of such lettering is usually considerably greater than that of the best of typewritten copy. In addition, the possible variations in the size of the letters formed by means of the mechanical guides is an advantage in balancing the typography of the slide and for emphasizing certain details.

At times an audience is asked to look at a very extended table of data. Very few people read such data since, in general, they are not interested so much in the particular values as in the general trend. With some thought the lettering or number of words can be reduced materially and often improved in clarity. If the rule as to the size of the letters were followed, many of the objections to extended tables of data would be removed because it would be impossible to show too much on one slide.

Some lecturers attempt to show a picture of their entire set-up. Almost anyone can arrange different pieces of apparatus into a complete set-up, but what does the audience care about that? Many such slides have been shown from which the people in the audience could learn nothing. They are interested in the final results and the special arrangements and precautions necessary to produce these results.

Whenever it is possible, slides should have titles. Then the audience will be sure that no mistake has been made, nor will the lecturer have to hesitate and seemingly study whether the slide was the one he intended to show at that time.

When curves are shown, coordinate lines should be drawn at least for the main divisions, since a curve does not show up well if there are no coordinate lines except the one at the bottom and the left-hand side. Slides look better if one does not photograph ordinary cross-section paper but uses cross-section paper where only the main division lines show. The curves should be drawn more heavily than the cross-section lines and the scale should be shown for both axes. In general, letters larger than those in a standard fifty letter sentence should be used for curves. Too many curves and too much lettering should be avoided. It is better to use another slide if more than three curves are to be shown unless the curves form a closely related family. The numerical value of the coordinates should be so marked that there is no question as to which line is meant. Someone in the audience may want to find the value for a particular condition. In general, all lettering should be horizontal except the designation of the vertical coordinate, and that should be on the left of the picture and run from bottom to top. (See figure 2).

[2] Lettering guides may be obtained from the Wood-Regan Instrument Co., 154 Nassau Street, New York City.

It is often possible to add much to the clearness of a chart by proper shading or toning of certain areas. This is usually accomplished by cross hatching. This process is tedious, and usually the results are far from neat unless the work is done by a capable draftsman. Such difficulties are easily avoided by the use of a transfer process for the shading of drawings[3]. Figures 2 and 3 illustrate this method of improving the background of certain slides.

Apparently too little study is given to illustrations and the structure of tables in good technical books by persons making slides. It should be remembered that the skilled printer has had long experience and has given a good deal of study to these matters. Even casual observation of these by anyone preparing drawings or lantern slides will insure against some of the prevalent evils existing in lantern slides.

Most slides as used are about 3¼ inches high and 4 inches wide. However, it is well to confine the illustration to no more than two-thirds the width and height since this will insure against some of the illustrations being eclipsed by part of the projection apparatus and, in the case of the cheaper projectors, against too much distortion.

It is almost a universal practice to make slides up as positive since this is then shown on the screen as a positive picture. It has been noticed that when a negative is shown there is apt to be some comment by the members of the audience to their neighbors. Negative slides often break due to the excessive absorption of radiant energy, which is a practical objection to them. Sometimes a lecturer will ask the operator to hold a copy of some plate in the lantern so as to project it on the screen. This is very difficult to do. Such a sample may easily be mounted on a slide.

Making a slide by cutting a piece out of a spectrum plate or other photographic plate is very unsatisfactory. Such pictures show up very badly and often are not even properly orientated. This method is excused by saying that no time or money was available to make good slides. The answer is that the lecturer imposed upon the time of his audience in trying to show them interesting results that they could not see, except with some effort.

Lantern slide emulsions are purposely contrasty and fine-grained. These characteristics usually go together in emulsions. While contrasty lantern slides are excellent for tabular matter and line-drawings, they are a great handicap where a variety of half-tones is to be illustrated. For example, lantern slides of interiors, of apparatus, of lighting effects, etc. are commonly unsatisfactory because of the high contrast and short range of shades. Many kinds of photographic emulsions are available with which the original negatives can be made. With careful printing and developing, a lantern slide positive can be made fairly satisfactory, although it is often more desirable to use one of the less contrasty emulsions for making the positive; for instance, the 3¼" × 4¼" plate, which can be obtained in a variety of emulsions. Of course one-fourth of an inch must be cut from its length. Obviously, panchromatic plates should be used in making the negative of colored originals if the relative brightnesses are to be reproduced with reasonable satisfaction. By a careful use of plates and proper emulsions, excellent lantern slides can be made from very poor originals or from originals which present difficulties for ordinary emulsions and contrasty lantern slide plates.

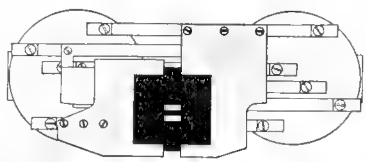


Fig. 3. A well made slide diagram of a special instrument showing shading. Taken from work of Luckiesh and Moss.

The usual mat adds a desirable finish to lantern slides. In special cases ingenuity can be exercised in making special mats. In fact, lantern slides can be built up of materials and mats placed between two thin glass plates, although one must be careful not to make the lantern slide too thick for the standard holders.

The slides must be put into the machine in the proper position and in the proper order to obtain the best results. In general, the slides for any single lecture should be marked in the order in which the lecturer wants to use them. If the slides are arranged in order in a slide box or in a pile, many things can happen to change the order, which may be very disturbing to the lecturer. To get the slides into the machine in the proper position calls for some marking since it is rather difficult for the operator to inspect each slide to see how it is to be put into the machine. If a slide is held between the eye and a light source in such a manner that the picture as seen on the slide is properly orientated, a turn of the slide through 180° in its own plane will bring the slide into the proper position for the lantern, providing the operator is facing the screen. A good plan is to have some mark, such as a small sticker, placed on the lower left hand corner of the slide, held as above described, and then, when

[3] A wide variety of transfer patterns may be obtained from Para-Tone Company, Inc., 416 Plymouth Court, Chicago, Illinois.

putting the slide into the lantern, have the slide so turned that this mark is in the upper right hand corner as the operator faces the screen. This method of marking is used so much that it may almost be considered standard.

Since the size of the slides is standardized, one would not expect to find slides so made that they will not go into the slide holder of a standard projection apparatus. However, at almost every meeting of a technical society, some one has slides that are so poorly made that the operator has difficulty in getting them in and out of the projection apparatus. Since the size and position of use of lantern slides are standardized, one would not expect to find pictures turned through 90°, but at the last meeting of one of the technical societies three or four of the slides for one paper, probably through the carelessness of the maker, were so made that the picture as shown on the screen was turned through an angle of 90°. It would be better not to show such evidence of carelessness. Some years ago at a meeting of another technical society, the audience was amused because, due to poor adjustment of the lantern each slide was slowly destroyed during its projection by being overheated.

We have all noticed at times that the operator has a great deal of trouble with his light source. Often he has to change the carbons or the lamps during the lecture. This is, in general, inexcusable and should be taken care of beforehand. At times the operator does not seem to know how to make the various adjustments on the projecting machine.

At a recent meeting of a national society one of the principal lecturers was very greatly annoyed by the appearance of his slides; some showed so poorly that he passed them without comment. Considering the field this man is interested in, it is certain that he provided good slides. At the meeting of another society where a lecture was given at the time a certain prize was awarded, the lantern failed and a technical lecture had to be delivered without the help of slides. A little care beforehand would avoid such unnecessary annoyances.

At a meeting of the Physical Society the electric line leading into the lecture rooms was so small that it was impossible to get sufficient power to operate the light source so that it would give enough light to show the slides properly. Several of the papers had to be presented without slides although slides had been prepared.

The ordinary wall outlet is, in general, not satisfactory for a large lantern. If it is necessary to use a large lantern, a special source of supply should be provided so that 10 to 15 amperes can be delivered to the lantern without very seriously changing the supply voltage. If this is not possible, a smaller lantern should be used, since much better projection can be obtained with a small machine operated properly than with a large machine if there is not a satisfactory electrical supply.

Care should be exercised by the operator in changing the slides. It is not a good practice to remove the slide and subject the audience to either complete darkness or to the glare of a white screen highly illuminated. Many methods are used to avoid this annoyance. Some slide-holding mechanisms are so made that the new slide can be pushed into one side of the machine and the old slide removed from the other side at the same time. Some machines have a slide holder so made that one motion pushes the new slide in and the return motion of the lever removes the old slide. If these work well they are quite satisfactory.

It is at times annoying to see the slides moving about as they are being changed. The best method of changing slides, therefore, is to use a double projection apparatus with some means of changing from one to the other. The picture may be changed by having an iris diaphragm before each projection lens so connected that a movement of a lever opens one of them and closes the other. One lamp may be turned off and the other lighted by a double throw switch. Another method is to have the resistance in the lamp circuit so connected that a movement of the contact dims one of the lamps and brightens the other. The last two methods require incandescent lamps since, in general, it is impossible to dim an arc or turn it off and on quickly. This method works with less noise and less disturbance than is possible by the use of a single projecting apparatus. At the present time good lanterns are so easily obtained that it seems hardly necessary to use one of the older lanterns which will not show even the best slides to advantage.

A very good method of showing an audience some special results is to use two separate lanterns and thus project two pictures at the same time. By this means the experimental arrangement or method of very special work can be shown on one slide and at the same time the other picture can show the results of the experiment. This is very effective where the results depend upon some changing conditions of the experiment. This method can also be used very effectively to show engineering data on some special machine under various conditions of operation. This could of course be done with a double lantern, if sufficient angle adjustment is provided.

Moving pictures are being used more and more to show results of research. For some work this is a good method of showing the data particularly if changing conditions are to be reported. Again the operator should be sure he knows how to

operate the machine. Recently at a technical meeting an audience was kept waiting while the operator worked out the method of operating the projecting machine.

At a recent meeting of the Illuminating Engineering Society, the slides did not show up well due to several causes, the principal one being that the electrical supply was not satisfactory. This meeting was held during the day time. The windows were not properly screened and too much light entered the room so that the pictures did not show up well. This often happens because the person in charge does not know just how much outside light can be permitted in a room and still show the slides. A good plan is to try such things out beforehand.

To show all parts of the picture equally well even with the best projection instruments, the screen should be perpendicular to the line of projection of the lantern. If a scientific meeting is held in a room that has a high stage, with the projection instrument located on the floor of the room, the angle between the screen and the line of projection is apt to be such that not only is the picture thrown out of shape but also it is impossible to get all parts of the picture in focus at the same time.

Sometimes a lecturer has prepared slides for projection on a screen about 8 or 10 feet wide and finds that a small machine is being used where the pictures are thrown on a screen about 4 feet wide. Nothing is more disturbing to an audience than to have slides shown in such a manner that the resulting picture is too small to be clearly seen. This was well illustrated at a recent meeting of the Physical Society much to the disturbance of many of the members. The width of the projected picture should be about one-tenth to one-twelfth of the distance to the persons in the audience who are farthest from the screen.

If a lecturer finds it necessary to use a poor lantern and then wants a particular part of the slide better focused, he should point out the particular part so that the operator will know what to try. The best that any operator can do is to adjust the lantern so that the part of the picture that he considers important is in good focus. The slides shown at a Chemical Society sectional meeting were very badly out of shape and one corner of each picture was blurred. This was found to be due to poor alignment of the projection lens and the rest of the lantern. It required a pair of pliers to loosen a screw so that the lens could be brought into proper adjustment.

Something should be said concerning the screen used. Generally, in regular lecture halls, fairly good screens are available. Sometimes these screens, due to long use, become so black with dust that a great deal of light is lost. A screen with a metallic aluminum surface is satisfactory in a long narrow room where no one is obliged to view the screen from a wide angle. The metallic surface reflects light predominantly in the direction of the projector and its brightness diminishes rapidly as it is viewed more and more obliquely. A screen with a white diffusing surface is approximately of equal brightness as viewed from all angles, and is universally satisfactory if the projection lantern is powerful enough. Aluminum screens are so often used in wide rooms, where they should not be used, that it would be a good rule to eliminate them entirely, or to use them only in the few specific cases where they would be permanently used in narrow rooms. The screen should be hung in such a manner that it will not move, because if it does, some part of the picture at times will be thrown out of focus.

At a recent lecture some good slides were shown with the lantern located on a balcony across a hall. This put the lantern in such a position that the line of projection was not quite perpendicular to the screen. The man at the lantern focused the instrument so that the upper edge of the picture was clear, with the result that the lower part of the picture was slightly out of focus. In this case, if the center of the picture had been made sharp, the top and bottom would have been very good. This difficulty was made more noticeable due to a back and forward movement of the screen. Sometimes the screen is so low that those in the back part of the room cannot see all the picture. In general, this can be taken care of as the screen can be raised and then tilted to bring it into the proper position with respect to the line of projection.

An almost universal mistake is made in showing lantern slides in a dark room. Powerful projectors are now available at a moderate price and there is no difficulty in projecting most lantern slides, particularly line-drawings and tabular matter, in a room which is moderately illuminated. A bright area on a projection screen surrounded by darkness is trying on the eyes of the speaker and the audience. When the room is dark the speaker is at the disadvantage of not being clearly seen. It is not generally recognized that the language of the speaker consists of more than words; it consists also of shrugs and gestures, facial expressions, etc. When a lecturer is speaking in the dark he loses much of his control of the audience, at least as far as the fine points are concerned. When he is in the dark the audience is "merely hearing a phonograph record" and somehow phonograph records are not as appealing as the original presentation. If the full light of the room is too much for the projector to overcome and the lighting is not divided into circuits so that a moderate light can

be obtained from the fixtures towards the rear of the room, one or two portable lamps do a good deal to reduce the trying conditions of a dark room on the audience and speaker.

While it probably does not disturb an audience seriously to have the lecturer call to the operator when he wants a slide changed, this is not a necessary disturbance. It is a simple matter to signal to the operator by means of a small lamp or buzzer operated by a switch in the hand of the lecturer, so that the operator can be informed when and how to show the slides. A lecture seems to be much more satisfactory if the slides appear when they are desired and the room lights come on when they are wanted, so that the lecturer will not need to call to the operator to tell him what he wants. There should also be available, without the necessity of the lecturer asking for it, a pointer of such length that he can point out anything that he desires on the picture. It may sometimes be satisfactory before a small group for a lecturer himself to operate the projection apparatus, but this should not be attempted at any formal lecture or at a meeting of any technical society.

Slides may be broken in transporting them to the place of lecture. However, one wonders if some of the broken slides shown were not broken in some other manner. The appearance of a broken slide on the screen may probably be excused, but there is no excuse for the soiled and dirty slides that are displayed from time to time. Finger marks are particularly objectionable and, even if slides are clean when handed to the operator, the latter sometimes carelessly leaves finger marks.

Too many slides should not be shown. It is well to turn on the lights occasionally and give the audience a rest from the slides. At times a lecturer will use a slide to illustrate a particular point and then will have considerable to say before the next slide is thrown on. It is better to turn on the lights for this interval and then turn them off again when the next slide is needed.

Often a lecturer attempts to show on a slide a very faint spectral line or some special image which was brought out very faintly on the original photograph. Perhaps the original was faint and the experimenter had to look very carefully to see what he had found. However, when showing this to an audience he should make the slide show to the audience exactly what he wants it to show. The line, or whatever he is desiring to show, should be made clear enough so that he will not have to explain. "Those up in front can see this line right here but those in back probably can not see it." No one is going to judge the value of a piece of research work entirely by what he sees on the slide—he is also apt to judge it by what he does not see. A poor slide can be faked as well as a good one and when a man is explaining to an audience exactly what he found on the plate he does not need to ask the audience to take the pains to see what he saw on the original photograph. There are methods known to those skilled in the art of making slides that can be used to bring out weak lines and other parts that showed poorly on the original plate.

Almost all the criticisms of slides and every suggestion as to methods of making better slides that have been given can be applied to the illustrations given in scientific papers. Many papers would be very much improved if better illustrations were provided.

The author's colleague at Nela Park, Dr. Matthew Luckiesh, has helped considerably by criticism and suggestions, and by furnishing material in the preparation of this paper, drawing upon his experience of making and showing slides obtained during his many years study and development of the general subject of the "Science of Seeing." The author wants at this time to express his appreciation for this help.

OPEN OCEAN AND COASTAL SHARKS: DO THEY ATTACK MEN?

(Continued from page 149)

known in the Woods Hole region, that there seems to be no room for doubt that it is a genuine case of shark bite.

Sharks certainly do bite men. I have had come to my office, a resident of New York City, who showed me the scars on his body left by an encounter with a shark in the West Indies. In certain parts of the world, such happenings are unfortunately far from infrequent. However, sharks are for the most part scavengers and timid fish. In those parts of the world where I have fished for them they are pretty generally held in contempt. Thus at Key West, I have seen boys diving for pennies off the old Mallory Line dock, while 200 yards away a dead horse, drifting out with the tide, was surrounded by four or five 10-foot tiger sharks bucking and surging, trying to tear it apart so that they could eat it. The point is plain—the tigers preferred dead horse to live boy. It may be added that I failed to get any accounts of shark attacks at Key West.

My fishing for sharks at Key West was mainly done five miles away from the docks, and off the slaughter house, where they fed on offal. There,

especially on the days when cattle were being butchered, 10 and 12-foot tiger and other smaller sharks could be seen cruising around the big coral heads seeking scraps. There I cruised also seeking sharks. One day I was steering our launch with a Key West harpooner up in front. We were talking about sharks attacking men and to test my man on the subject, I said, "Griffin, suppose I were to run the launch up on a coral head and dump you overboard, wouldn't we have a funeral in Key West next day?" He turned to me and earnestly answered, "No sir! Everybody here knows that these sharks won't attack anybody. If I were to go overboard near them, they would head for Cuba at top speed."

To this I said "Griffin, I'm no tenderfoot. I've done considerable fishing for sharks. Those big fellows out there would surely get you alive." But, much offended, he answered, "Well, Doctor, if you don't believe me, steer me up to those sharks and I'll jump over on his back, and we will see him make for deep water scared nearly to death."

So sure was I that the man was telling the truth, that had I not needed specimens I would have taken him at his word—and to this day I regret that I did not do so. Such an experiment has been done—at Calcutta, where the Hooghley River is full of reputedly dangerous sharks. I have an authentic account of a drunken sailor there who, on a wager, jumped overboard and landed feet first on the back of a shark lying alongside the ship, and the shark—as well as the sailor, sobered by his plunge—was scared nearly to death.

But sharks certainly do attack men. The earliest reputable account of such known to me is in a book by the old Dutch navigator, Jan Huygen van Linschoten, who made a voyage to the East Indies in the late years of the sixteenth century and published his account at "Amstelredam" in 1595. This is said to have happened at Cochin near Madras, India. In the *Fugger News Letter* (1924), there is a translation of a letter from Cochin dated January 10, 1580, giving an eyewitness account of a similar but earlier happening there.

Many other voyagers have recorded similar attacks, but our most authentic data is contained in the writings of medical men. The earliest of these accounts known to me were published in 1828 and 1829, but I cannot give the locality since they have not been looked up. I have, I believe, all of these medical references, and I hope some day to prepare an historical article that will bring together all the accounts that have been written on this subject.

As has been indicated, the Hooghley River at Calcutta abounds in sharks. Sir Joseph Fayrer was surgeon in chief of the Calcutta Hospital in the third quarter of the last century and from 1868 to 1873 he recorded five cases of shark bite on which he had been called to operate. He gives a figure of the head of a man's femur which showed grooves made by the teeth of a shark.

Probably this concentration of cases of shark bite at Calcutta is to be explained by the fact that many of the Hindoos consign their dead to the Ganges. As the corpses float down the river, the sharks feed on these. Having acquired a taste for human flesh, like the man-eating tiger, the tiger of the sea presently comes to take his food in the shape of living men.

The "sharkiest" waters in the world are those of southeastern Australia and particularly Sydney Harbor and its bays and coves. So many and frequent have been the fatalities there, that the bathing beaches have all been fenced off by wire enclosures. For the many shark attacks in these waters, we have two compilations of data that can be depended on. These can only be briefly summarized here.

In 1933, Dr. Victor Coppleson, visiting surgeon to two hospitals in Sydney, published in the *Medical Journal of Australia* his paper, "Shark Attacks in Australian Waters." From doctors' and hospital records, Dr. Coppleson lists 38 attacks on bathers by sharks since 1919. He analyses the method of attack, the wounds caused (with two photographs as illustrations) and the method of treatment. This is a most valuable paper.

Two years later, Mr. Gilbert P. Whitley, the accomplished ichthyologist, of the Australian Museum published a paper, "Australian Shark Tragedies" (*The Victorian Naturalist*, 1935, vol. 51, 195-206). From 1803 to August 26, 1934, he lists "a total of 70 or 80 fairly authentic cases of sharks attacking human beings in Australia." This is indeed a huge list of shark-caused tragedies for the smallest continent, and indeed mainly for its east coast, but this is not the place to enter into any study of these. No simple explanation, like that offered for the Calcutta attacks, can be set out. Much critical study of the accounts will need to be made. This must be left for the detailed paper at a later date.

Coming nearer home and narrowing down the range of our investigation, I can assure my readers that I know of but two articles giving definite accounts of shark attacks in these waters. The first is so far away—in the Caribbean Sea near Colon, Panama Canal Zone—that it need not detain us. But when we came so near home as Charleston, S. C., it is a different matter.

In 1935, Mr. E. Milby Burton, Director of the Charleston Museum published (*The Scientific Monthly*, vol. 40, pp. 279-283, 2 figs.) accounts of 6 attacks on the South Carolina coast. He gives times and places, names the person attacked, the

hospital where treatment was given, the name of the attending surgeon, and figures of some of the wounds. This is one of the best authenticated reports known to me.

Coming still nearer home—to the coast of New Jersey—it will be recalled that in July, 1916, the newspapers were filled with accounts of swimmers fatally attacked by a shark or sharks in the tidal mouths of New Jersey rivers. These accounts were investigated and found true by R. C. Murphy and J. T. Nichols, whose report was published in the *Brooklyn Museum Quarterly* (1916, vol. 3, 144-160, ills.). Later in July, a white shark (*Carcharodon carcharias*), the so-called man-eater, was captured off South Amboy. In 1919 or 1920, I saw in a fish shop near Eighty-sixth Street and Broadway, New York, the jaws of a shark labelled as those of the "New Jersey man-eater." The characteristic broadly triangular saw-edged teeth showed the shark to have been a *Carcharodon*.

Murphy and Nichols by a process of elimination narrowed the possible attacker down to the white shark and their presumptive evidence that it was this particular fish is strong, but it is not *proof* and is not offered as such. The proffered award by the late Hermann Oelrichs of $500 for an absolutely authenticated case of a shark-bite-man north of Cape Hatteras stood for many years but was never claimed.

The man-eater (or white) shark, has been sparingly recorded north of Cape Hatteras. In addition to the New Jersey fish of 1916, one was reported from Woods Hole in 1871, and two in 1903. These three records of this shark for the Woods Hole region (which includes the bay between Woods Hole and New Bedford, only 20 miles away) lend credibility to the account of the attack at New Bedford. However, no attack has ever before been recorded from New England waters. Up to the present time, the "farthest north" for such attacks is the New Jersey coast and the time 20 years ago.

What was the shark that did the hurt is a question easily asked but difficult to answer. The only way I can go at it is by the Murphy and Nichols process of elimination. The sharks of the Woods Hole region capable of such damage are of comparatively few kinds. The very abundant but harmless sand sharks have never been known to attack a swimmer. The hammerhead, grotesque in appearance and growing to at least 12½ feet long, is feared, but my experience is that it is not dangerous. The tiger or leopard shark grows to 12 or 14 feet and has a huge mouth filled with sickle-shaped teeth. Its name comes from the short vertical dark bars on the sides. In my four seasons' experience with it in southern Florida, its name is not borne out by its habits.

These sharks are all shallow water forms, but there are three surface dwellers out in the open sea, any one of which might have come inshore and have hurt the boy. The blue shark grows to a good size, but there is no record known to me of its attacking man. Next we come to the fierce ravenous mackerel sharks. To this group belongs the *mako* of Australian and New Zealand waters where it is held to be a man-eater. Lastly we have the true man-eater, the white shark, *Carcharodon carcharias*. This great shark is found in the open ocean where it is alleged to follow ships for fragments from the galley and for dead bodies consigned to the deep. It seems very likely that it or a mackerel shark is the predator that bit the boy.

This, however, is belief, not proof. Nor can the unfortunate death of the boy be absolutely set down as due to the attack of a shark until record is made of it by the attending surgeons at the hospital, or until all the evidence has been collected, critically tested and set out by some scientific man from the Marine Biological Laboratory at Woods Hole but a few miles away. It is greatly to be hoped that such a report will be forthcoming. The opportunity is an inviting one.

Sharks, almost anywhere, even in our waters, may attack men under certain circumstances. 1.—If surprised, cornered or crowded, a panicky shark like a scared rat will bite. The New Bedford shark might have been trying to swim down a channel, up which the boy may have been swimming. Under such a condition, any shark anywhere would pretty surely snap at a swimmer. 2.—A wounded and angry shark will bite a man. At Key West I have had a harpooned tiger shark with every appearance of anger seize the stem of the boat in its jaws as a dog lays hold of the nose of a cow. This one left the marks of its teeth in the wood. And 40 years before my time, C. F. Holder had a similar experience at the Tortugas. 3.—A ravenously hungry shark (and most of them are hungry most of the time, since their secretion of hydrochloric acid is prodigious) would attack a man. Such have been known to bite oars and boat hooks and have apparently tried to overturn boats to get at their occupants. The Woods Hole attacker probably sought his victim because of hunger. In the absence of schools of bluefish or mackerel, a shark in the open sea would be hard put to it for food, and driven by hunger might come in shore seeking what he might devour.

But for all this, bathers at Woods Hole and New York and New Jersey resorts need not be debarred from their favorite sport by fear of sharks. For all their bad reputation, most of our sharks are timid and are kept at a distance by the splashing of a crowd of bathers. Moreover, the fierce sharks, the mackerel and the man-eater,

rarely come inshore in our waters. To begin with they seem to be few in numbers and certainly there is little food for them near our shores to entice them in.

Shark hunters have been very busy this past week in Buzzard's Bay and contiguous waters. To the amateurs among them, information as to how to kill a shark when caught may not be amiss. A popular book of the day to the contrary notwithstanding, sharks are not to be killed below or above water by a simple thrust of a knife in the throat and heart region. I have never tackled a harder proposition than to try to "stick" a shark "pig-fashion" even with its head held above water. An easier way is, with the shark hooked or entangled in a net, to pull its head out of water and hit it a hard blow on the snout with a hatchet, a piece of iron pipe, or a wooden club. The shock transmitted through the olfactory nerves to the brain will at once put the shark *hors de combat*.

THE ANNUAL MEETINGS OF THE MARINE BIOLOGICAL LABORATORY

For many investigators of the Marine Biological Laboratory, Tuesday is a busy day as three official meetings will convene. In the morning the Trustees of the Corporation elect two new members to their Executive Committee, and the Chairman of their board; they also elect certain investigators at the Laboratory to membership in the Corporation. It is understood that more applications have been submitted for action than is usual.

The Members of the Corporation meet at half past eleven in the morning and when they adjourn, the Trustees are given a special dinner at the Mess Hall. The Trustees will convene again in the afternoon to assimilate the results of the Corporation meeting and to consider any "continued" or "new" business that may be brought before them.

The Corporation meeting promises to be an interesting one and it is unlikely that any member in Woods Hole will absent himself from the Auditorium for the hour around noon. Trustees must be selected by ballot this year, for one or more Corporation members are submitting nominations to Dr. Packard, Clerk of the Corporation, which must be considered by the Corporation as a whole together with the eight candidates sponsored by the Nominating Committee which are: H. B. Bigelow, Robert Chambers, Walter E. Garrey, Caswell Grave, S. E. McClung, A. P. Mathews, C. R. Stockard and Samuel O. Mast. The last-named candidate has been proposed to replace Dr. Greenman who is uneligible for re-election because he has reached the age limit; the Committee recommends that he be made Trustee Emeritus.

A number of desirable candidates made the selection of a successor to Dr. Greenman a difficult one. Dr. Mast was chosen because of his outstanding work in biology, his constant attendance at the Laboratory, and his productivity in graduate students. Someone has stated that Dr. Mast's opposition to certain phases of Jacques Loeb's work explains why the Laboratory has been so long in officially recognizing his accomplishments.

POSSIBLE MEMBERS OF THE CORPORATION FOR THE BOARD OF TRUSTEES

Many members of the Corporation of the Marine Biological Laboratory are eligible for Trusteeship; it seems appropriate at this time to acquaint the members of the Corporation with the accomplishments of certain of their fellow members who are being considered as candidates for election to the Board of Trustees. The brief biographical sketches given do not, of course, even begin to exhaust the many men who deserve to be honored by trusteeship.

Dr. Henry Bryant Bigelow

Graduating from Harvard in 1901, Dr. Bigelow carried on further studies there and has held various positions at the University, his present title being Curator of Oceanography. His first work was at the Woods Hole Oceanographic Institution.

During the World War, Dr. Bigelow was a reserve officer in the United States Army and served as special expert on the U. S. Shipping Board from 1917 to 1919.

He is a Fellow of the American Academy of Arts and Sciences, of the Royal Geographic Society of London and of the Boston Society of Natural History.

Dr. Robert Chambers

Born in Turkey and a graduate of Robert College of Constantinople, Dr. Chambers also studied at Queens College in Kingston, the University of Munich, and has done research work at Columbia University. He has taught in Turkey, at the universities of Toronto and Cincinnati and at the Cornell University Medical School. He is now

research professor of biology at the Washington Square College of New York University.

Dr. Chambers has carried on summer investigations at various laboratories, both on this continent and abroad, but for the most part has devoted himself to experimental work at the Marine Biological Laboratory, first spending a summer here in 1912. He is the recipient of scientific honors in recognition of his research contributions, such as the Traill Medal presented by the Linnean Society of London and the John Scott medal.

Dr. W. C. Curtis

Dr. Curtis, a graduate of Williams College and a former student at the Johns Hopkins University, has been professor of zoology at the University of Missouri since 1908. At Woods Hole he was instructor in the invertebrate zoology course before being elected trustee of the Marine Biological Laboratory in 1923. He was expert witness in 1925 at the Scopes trial in Dayton, Tennessee, chairman of the biological division of the National Research Council, as well as editor of the *Journal of Morphology and Physiology,* and president of the Union of American Biological Scientists.

Dr. Caswell Grave

Studying at the Johns Hopkins University after his graduation from Earlham College in Indiana, Dr. Grave taught zoology there and at Goucher College before transferring to the University of Washington, St. Louis, where he is Rebstock professor of zoology and directs the work of the department. He has also been Director of the United States Bureau of Fisheries Laboratory at Beaufort, North Carolina, and Shellfish Commissioner of Maryland. Dr. Grave has been secretary-treasurer and vice-president of the American Society of Zoologists. He first came to Woods Hole in 1901; beginning in 1912 he was instructor in charge of course work at the Marine Biological Laboratory for seven years.

Dr. W. E. Garrey

Dr. Garrey studied at Lawrence College, the University of Berlin and the University of Chicago. He has held positions in the physiological sciences at Cooper Medical College, Washington University (St. Louis), Tulane University and Vanderbilt University Medical School where he has been professor of physiology since 1925. He has held an instructorship in physiology at the Marine Biological Laboratory since 1924. He is a member of the Physiological Society and the Society of Biological Chemistry. His work has been largely in the field of comparative physiology.

Dr. S. O. Mast

Dr. Mast, professor of zoology at the Johns Hopkins University, first studied at the University of Michigan, Harvard University and at the Michigan State Normal College. He has taught in the field of zoology successively at Hope College, Goucher College, and the Johns Hopkins University. He is on the research staff of the course in invertebrate zoology at the Marine Biological Laboratory of Woods Hole. Dr. Mast is a long time resident of Woods Hole and many of his graduate students have worked here.

Dr. A. P. Mathews

Dr. Mathews, professor and head of the department of physiological chemistry at the University of Cincinnati studied at the Massachusetts Institute of Technology, Cambridge University, the University of Marburg and Columbia University. He has held positions in the biological field at the Massachusetts Institute of Technology, Harvard Medical School, Tufts College, Harvard University, the University of Chicago and the University of Cincinnati where he has been since 1919. He is a member of the Society of Naturalists, Physiological Society and Chemical Society. He was in charge of the work in physiology at the Marine Biological Laboratory from 1904 to 1916.

Dr. Charles R. Stockard

Dr. Stockard, a native of the state of Mississippi, matriculated at Mississippi Agricultural and Mechanical College. He studied, as well, at Columbia University, the University of Cincinnati and at the University of Würzburg. He has held the position of assistant in zoology at Columbia University and has since then been at the Cornell University Medical College where he is now professor and head of the department of anatomy. He is managing editor of the *American Journal of Anatomy* and co-editor of the *Journal of Experimental Zoology.* He is on the Board of Science Directors of the Rockefeller Institute. He has been president of the Society of Zoologists, secretary-treasurer of the Association of Anatomists and secretary of the Society of Naturalists as well as member of the National Academy of Sciences.

Dr. Wm. Randolph Taylor

Dr. Taylor has been professor of botany at the University of Michigan since 1930 and has been in charge of the botany course at Woods Hole since 1919. He received his Ph.D. degree from the University of Pennsylvania in 1920 and taught at that institution for ten years. He has had editorial connections with such publications as *Botanical Abstracts, Biological Abstracts, Stain Technology,* and others.

Dr. Taylor has done research work in cytology; the morphology of chromosomes; algae; marine algae of Florida, the Caribbean, and South America; and fresh-water algae of British Columbia and Newfoundland.

SUPPLEMENT TO THE DIRECTORY

Investigators

Nicoll, P. A. asst. zool. Washington (St. Louis). K 10.
Sandow, A. instr. biol. biophys. New York. OM NDR. Nickerson, Millfield.
Schoenborn, H. W. grad. asst. biol. New York. Br 232. Bosworth, North.
Schmidt, Ida G. asst. prof. anat. Cincinnati. Br 341. Pond, Prospect.
Schmidt, L. H. fell. biochem. Cincinnati. Br 341. Pond, Prospect.
Shears, Elizabeth. sec. Rockefeller Inst. (Princeton). Br 206. A 209.
Smelser, G. K. instr. anat. Columbia. Proto lab. D 302.
Steiman, S. E. grad. Boston. Br 228. McLeish, Millfield.
Whedon, A. D. prof. zool. and phys. North Dakota State. OM 38. A 202.

TROUT LAKE LIMNOLOGICAL LABORATORY

The interrelation between sponges and the presumably symbolic algae usually found in their tissues provides a host of problems upon which little has yet been attempted, but which may prove of primary importance in the explanation of sponge distribution.

The Woods Hole Yacht Club will hold its annual dance tonight at the Woods Hole Golf Club house. A Boston orchestra, secured through Ronny Weeks, will supply the music. A meeting for the election of officers will be held beforehand.

Introducing

John Z. Young, fellow of Magdalen College, Oxford University, and of the Rockefeller Foundation for Medical Research.

Mr. Young was born in Bristol, England, in 1907 and attended Malborough College and Oxford University. He matriculated at Oxford in 1928, taking his degree in zoology. He now holds the post of University demonstrator in the department of zoology, Oxford University.

In connection with his research he has published some twenty papers mostly on the following subjects: the anatomy and physiology of the autonomic nervous system of fishes, the pineal eye and other light receptors of lampreys, the cytology of the nervous systems of Cephalopods and Crustacea, and nervous degeneration and regeneration in Cephalopods.

Since December Mr. Young has been working at the University of Chicago on the innervation of the adrenal glands, and the potential changes in the brain of frogs. At Woods Hole he is studying the anatomy and physiology of the nervous system of squids, which contain giant nerve fibers over one millimeter in diameter.

Mr. Young will return to England early in October to resume his work at Oxford University.

INVERTEBRATE ZOOLOGY CLASS NOTES

The Invertebrate class, only recently arrived at Woods Hole, makes its bow. It may be seen in session daily and nightly from ten on. Since its members have taken to evening dips, sessions begin after the bath.

The latest innovation is Sunday morning lectures. Dr. Nelson delivered an impromptu one on the Portuguese Man o' War which has recently been placed in the laboratory, and his audience heartily approved. May we have more, Dr. Nelson?

Having survived the strain of the search for protozoa, we are starting the study of the coelenterates and, with it, our field work has begun in earnest. Since we are new, there are many things to learn. Dr. Hadley tells us that the technique for demonstrating an unknown form consists in jerking one's elbow suddenly, thus sending the animal back into the Sound and saving the leader much embarrassment. Dr. Hadley, by the way, has recently been known to stand blithely on a large Busycon, without being aware of its presence. Among the rare forms was one, named by Dr. Lucas as Ascanna. Ascanna? Well, ask Hannah!

The Nobska trip was a great success. Not only was the collecting the best reported for some years, but this was the first fair-weather trip in eight or nine. The following are some of its high spots. Are collectors bathers? May invertebrates go half unclad. The class has already had a run-in with the law. The Nobska cop spent an energetic twenty minutes running up and down the beach like an anxious hen with a family of ducklings. No one within reach, no names to call, no one who would reply to his wild wavings! And upon our arrival home, after much searching, Team II produced *Triphora perversa*, a snail with a left-handed coil, which was immediately kidnapped by Dr. Mathews for the permanent museum collection.

Aside from the intellectual, we have learned from Dr. Nelson, that "there are other means of amusement." Such we found was the truth when we trouped to the M. B. L. Mixer on Saturday night, returning thoroughly mixed and much impressed with the club's facilities. It furnished a welcome diversion from our strenuous activities—such a diversion that we unanimously substituted funny papers for check lists on Sunday morning.

Altogether, the Invertebrates are enjoying life at "the Hole" immensely. We feel that the summer shows great promise, and look forward to the next adventure.

D. Bishop, R. Babcock, M. Stoker

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

ELECTION OF NEW TRUSTEES

It is the opinion of many members of the Corporation of the Marine Biological Laboratory that, in principle, nominations for Trustees of the Corporation should be made by individuals as well as by the nominating committee appointed by members of the executive committee, themselves Trustees. In this way one can be certain that the choice of each Trustee represents the wishes of the majority of the Corporation members; in the past this has not always been the case. Since the officers and trustees of the Corporation are elected by the Corporation members, it should be the duty of each one to encourage the selection of Trustees by vote instead of by appointment. Individual or collective opposition at the meeting to nominations from the floor, such as has exhibited itself in the past, emphasizes the real need for them. The fact that such procedure is frowned upon by influential Trustees is unfortunate. The function of a conscientious nominating committee is to serve in an advisory, rather than in a dictatorial capacity.

If nominations, other than those of the nominating committee, are submitted for consideration at the annual meeting on Tuesday, a loyal member of the Corporation should not vote for an individual for trusteeship *simply* because he was chosen by the nominating committee; if other candidates of worth are presented, they should be considered with the same grace.

Many members of the Corporation, who have not served on the Board, are eligible for Trusteeship. Nominations from the floor are constructive; *they should be a custom, not a novelty.*

RECOMMENDATIONS OF THE INVESTIGATING COMMITTEE

The report of the Committees appointed several years ago to study "the matter of the nomination of officers and trustees" of the Corporation of the Marine Biological Laboratory of which Dr. W. C. Curtis was chairman should be in the minds of all corporation members today. They made a thorough study of the situation. Some of their recommendations are here reproduced:

(1) After considering various methods by which those engaged in instruction might be represented upon the Board of Trustees, it is believed that the following action by the Corporation will be the best means of insuring such representation:

"The Corporation affirms its position that instruction is a fundamental part of the work of the Laboratory and hence this work should be adequately represented upon the Board of Trustees."

(2) "That the Committee of the Corporation for nomination of Trustees consist of five members, of whom not less than two shall be non-Trustee members of the Corporation, and not less than two shall be Trustee-members of the Corporation."

(3) "That on or about July first of each year, the Clerk shall send a circular letter to each member of the Corporation giving the names of the Nominating Committee and stating that this committee desires suggestions regarding nominations.

(4) "That the Nominating Committee shall post the list of nominations at least one week in advance of the annual meeting of the Corporation."

(5) "That no trustee shall be elegible for reelection until one year after the expiration of the term for which he was elected."

Introducing

GREGORIO T. VELASQUEZ, special detail fellow from the University of the Philippines to the University of Michigan.

Mr. Velasquez was born at Calumbit, Bulacan, Philippine Islands in 1901 and attended the University of the Philippines. He was made assistant in botany in his third year, assistant instructor, after receiving his Bachelor of Science degree in 1925, and instructor in 1930 Working under Professor José K. Santos, cytologist, Mr. Velasquez received his Master of Science degree in 1931.

Since last February he has been studying at the University of Michigan, Ann Harbor, Michigan, under a special detail from the University of the Philippines and a fellowship from the University of Michigan. His wife, who is assistant in the department of zoology at the University of the Philippines, accompanied him to Michigan where she is working for her Master of Arts degree in zoology.

At Woods Hole he was enrolled in the botany course. His special interest is the algae of the Philippines, specimens of which he has brought with him for study; little research has been done on these in the Philippines.

In the fall Mr. Velasquez will continue his studies of algae at the University of Michigan under Dr. W. R. Taylor under whom he has been working since his arrival in the United States.

E. T.

ITEMS OF INTEREST

DR. JOSEPH SCHWAB, instructor in biology at the University of Chicago, will be research associate in the Bureau of Educational Research in Science at Columbia University for the next year. Along with five others he will prepare a two year beginning course in natural sciences. Dr. Schwab is now working at the Marine Biological Laboratory.

DR. WILLIAM H. COLE, director of the Mt. Desert Biological Laboratory at Salsbury Cove, Maine, will be at Woods Hole on Tuesday, August 11. Dr. Cole is a member of the executive board of THE COLLECTING NET Scholarship Fund.

FATHER FRANK J. O'HARA, formerly of St. Edwards University, Texas, will occupy the post of instructor in embryology at Notre Dame University. The new biology building, worth $300,000, will be opened in the fall. It is equipped on the first floor with complete facilities for bacteriology in addition to an "ultra-modern lecture hall," on the second for botany and forestry and on the third for all other branches. Convenient greenhouses will provide specimens for the botany courses.

Dr. Henry Drysdale Dakin of Scarborough, New York, who is editor of the *Journal of Biological Chemistry* has had conferred upon him the honorary degree of Doctor of Literature by the University of Leeds.

DR. EDWARD J. RILEY, member of the staff of the New York University College of Medicine, died of an acute throat infection last Tuesday at St. Vincent's Hospital where he had been visiting physician for the past 12 years.

MR. ARCHIE N. SOLBERG, Columbia graduate student, has received a university fellowship in zoology at Columbia University. Mr. Solberg, who worked at Woods Hole during the early part of the summer is now visiting at his home in Fargo, North Dakota.

DR. R. P. WODEHOUSE, botanist and chemist for the Arlington Chemical Company, Yonkers, is the author of a book on the morphology of the pollen grain. It is entitled "Pollen Grains."

The issue of *Science* for August 7 contains an article entitled "The Semiquinone of the Flavine Dyes, including Vitamin B_2" by Drs. Leonor Michaelis, M. P. Shubent and C. V. Smythe. The last member is a former COLLECTING NET scholar. This same issue also contains "Survival of Ascaris Eggs After Centrifuging" by Professor H. W. Beams and Professor R. L. King and "Electrical Brain Waves and Temperature" by Professor Hudson Hoagland.

The Blakiston Exhibit in the Lobby of the Brick Building of the Marine Biological Laboratory ended on July 31. The W. B. Saunders' books were on display for several days around August 1. The Macmillan Company has just completed its exhibit with three of the staff in attendance. Lea & Febiger has taken the latter's place in the lobby with an exhibit of books in the biological sciences, with special emphasis on medicine.

The *Atlantis*, Woods Hole Oceanographic Institution research ketch, will sail on Monday morning to set up current stations off Block Island on the continental shelf. The object of the trip, which is under the direction of Dr. Henry Stetson of Harvard University, is to get data on one complete tidal period.

The *Alda* from New York, which anchored in Great Harbor off the laboratory wharfs is owned by Mr. A. V. Davis, President of the Board of Trustees of the Aluminum Company of America. The boat, which arrived shortly before nine last night, is 154 feet long, with a 24-foot beam; its displacement is 373 tons, with a maximum crusing speed of 17 knots. Mr. Davis visited Woods Hole about ten days ago in the black and white vessel with the glistening metallic trimmings, we understand he will be here again for several days. He is here to visit his brother, A. K. Davis, who owns the Golf Club and course.

The *Rose Way* of Rock Island, captained and owned by Harold Hathaway of Taunton, Massachusetts, put into Woods Hole last week with a catch of swordfish. Captain Hathaway reported seeing great numbers of sharks; one large shark even tried to get at a swordfish slung over the side in a barrel!

The schooner *Massoit* burned at the water's edge near Great Round Shoals last night. The patrol boat *Argo* was rushed to the scene, but what rescues she accomplished are as yet not known; the *Argo* will arrive in Woods Hole later this afternoon.

The German zeppelin *Hindenburg* was greeted by the more observant element of Woods Hole this morning a little after eight o'clock. She was on her way to moor in Lakehurst, New Jersey, having taken off from Frankfurt three days ago.

A three-legged duckling which uses its extra leg to sit on has been hatched on the Cape. The third leg is slightly smaller and drags behind when he is walking.

The aerial photograph of Woods Hole reproduced in this issue of THE COLLECTING NET was taken by Howard M. Wood of New Bedford as well as the other two which were printed in earlier issues this summer.

ITEMS OF INTEREST

NOTES FROM THE TECHNICAL DIRECTOR OF THE MARINE BIOLOGICAL LABORATORY

The Marine Biological Laboratory is fortunate in securing the temporary services of Mr. Ray E. Phipps, mechanic in the Department of Physiology, Cornell Medical School and former mechanic at the Laboratory here, for repairs and new constructions much needed at the present time.

Mr. George D. Barclay who has been at the Laboratory for the past few weeks, assembling and erecting the new x-ray outfit will return to New York this week. He will complete accessory instruments for x-radiation in connection with the present equipment, under the direction of Dr. G. Failla, physicist at the Memorial Hospital, of New York City.

It is desired that investigators submit recommendations and any helpful criticism concerning scientific equipment which will be of direct value in experimental work at the Laboratory. Forms have been distributed so that the Apparatus Department may know where anyone has been handicapped or will be benefitted. Additional copies of the information blank may be secured at the Apparatus Room.

CHANGES AT ROCKEFELLER INSTITUTE

The board of scientific directors of the Rockefeller Institute for Medical Research has announced the following appointments and promotions to the scientific staff. Dr. Irvine H. Page has been promoted from associate to associate member; Drs. Alexandre Rothen, John M. Steele and Robert S. Tepson from assistants to associates; and Drs. W. Halsey Barker, Rollin D. Hotchkiss, Hubert S. Loring and George L. McNew from fellows to assistants.

The new appointments include Dr. Rafael Lorente de Nó, associate; Drs. Robert D. Baird, George K. Hirst, Horace L. Hodes, Austin L. Jogner, Charles L. Mehltreller, Benjamin F. Miller, Carl G. Niemann, John A. Saxton, Jr., and Mr. Leonard C. Kreider, assistants; Mr. August A. Di Somma and Dr. Carl G. Harford, fellows.

Louis Olivier, student at the University of Michigan Biological Station at Douglas Lake and bachelor of science from the University of Michigan, has been appointed graduate assistant in the zoology department at New York University. Dr. Carl Venard, who held this position last year, will be instructor in zoology at Ohio State University.

"CAPE COD IN COLOR"

Movies reproducing in color the glory of the Cape, its inland scenery and seascapes, its monuments and historic spots, lighthouses, harbors and ships and its busy contemporary life will be presented by the Rev. W. J. Miller of Orleans, Massachusetts, for the benefit of The Collecting Net Scholarship Fund. The film will be shown in the Auditorium of the Marine Biological Laboratory at Woods Hole on Thursday evening, August 20th, at 8 o'clock.

Dr. Miller is not a native of Cape Cod. He came here four years ago to take a church at Orleans. As often happens when a stranger, sensitive to the challenge of exploration, finds himself in new and historic surroundings, Dr. Miller set out to learn the history of his new environment and of its past and present inhabitants. Caught by the charm and color of old homes, quaint customs, and characters whose prototypes have been made familiar through the writings of Joseph Lincoln, he took his camera with him to make a graphic record. He and Mrs. Miller have spent two years covering the territory between Provincetown and Yarmouth, shooting scenes and gathering a wealth of knowledge of the folktales, legends, and history of the Cape, which they have incorporated in the lecture. Dr. Miller does not consider the film yet complete but hopes to cover the rest of the Cape before he must return West.

He considers himself an amateur, and this, together with the fact that even professionals consider color photography to be still in its infant state, will make "Cape Cod in Color" interesting entertainment for both scientist and summer visitor.

FORTHCOMING ARTICLES IN "GENETICS" (September)

Rhoades, M. M., A cytogenetic study of a chromosome fragment in maize.

Sonneborn, T. M., Factors determining conjugation in **Paramoecium aurelia.** I. The cyclical factor —the recency of nuclear reorganization. II. Genetic diversities between stocks or races.

Hays, F. A., Studies on the inheritance of persistency.

Chesley, P. and Dunn, L. C., The inheritance of taillessness (Anury) in the house mouse.

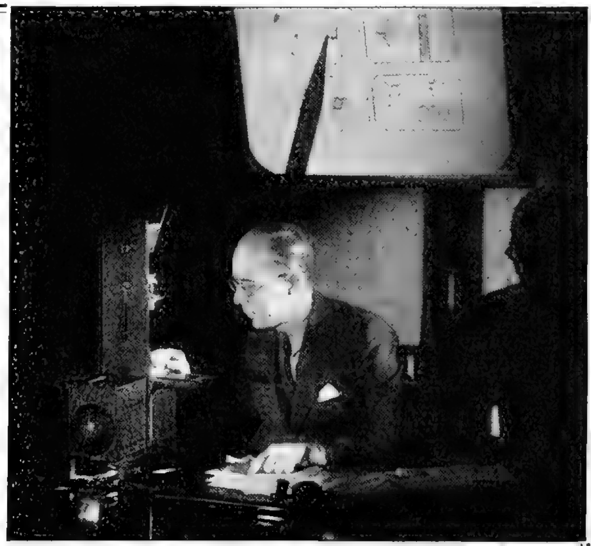
Husted, L., An analysis of chromosome structure and behavior with the aid of x-ray induced rearrangements.

Sturtevant, A. H. and Beadle, G. W., The relations of inversions in the X-chromosome of **Drosophila melanogaster** to crossing over and disjunction.

Nebel, B. R., Chromosome structure. X. An x-ray experiment.

Steinberg, A. G., The effect of autosomal inversions on crossing over in the X chromosome of **Drosophila melanogaster.**

Here's a Projector



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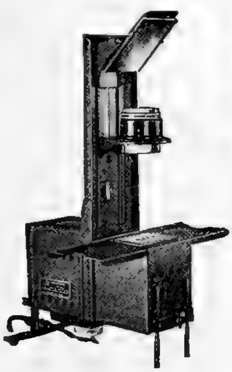

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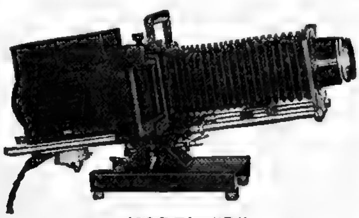

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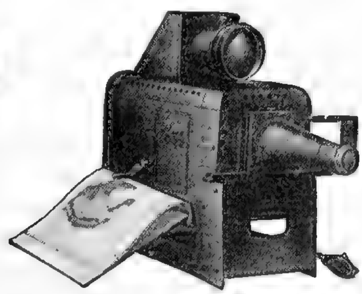

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DEPARTMENT OF PUBLICATIONS

NEW EDITION OF POPULAR TEXT IN HUMAN PARASITOLOGY

INTRODUCTION TO HUMAN PARASITOLOGY, Asa C. Chandler, Fifth Edition, xvi + 661 pp., 308 figs. $5.00. 1936. John Wiley and Sons.

In the fifth edition of the "Introduction to Human Parasitology," Professor Chandler has revised his popular text book to include advances in the field, which during the past six years have been so numerous and so important that the previous edition was no longer a correct and adequate presentation of the subject. In the preface to the new edition he lists some of the discoveries which led him to prepare the revision. They include important contributions in all branches of the subject, in protozoology, helminthology and medical entomology.

The first three editions of the work (1917-1926), published under the title, "Animal Parasites and Human Disease," were written as a semi-popular treatise designed to present the more significant facts of human parasitology in a form which would be useful and stimulating to the general reader as well as to students. In the last two editions (1930, 1936), published as a text book, "Introduction to Human Parasitology," the author has in large measure retained the style of the earlier ones, and the subject matter is presented in a clear and readable manner. The book is sufficiently non-technical to be intelligible to the average college student and at the same time complete and comprehensive enough to serve as a standard text and reference work.

The book deals with the entire range of animal parasitology and in this respect may be compared with Leuckart's, "Die Parasiten des Menschen," and Brumpt's "Précis de Parasitologie." It is about equally divided into protozoology, helminthology and medical entomology. There are more complete works on human protozoology, e.g., those of Wenyon, Reichenow, and Craig; more complete works on helminthology, e.g., those of Faust, Sprehn, and the several monographs on constituent groups; more complete works on medical entomology, e.g., those of Matheson, Riley and Johannsen, and the two volume treatise of Patton and Evans; but the new edition of Chandler contains in briefer form a statement of the more important facts presented in the extensive monographic studies. Professor Chandler is not merely a compiler, but an original investigator with the experience and judgment to make an adequate selection and digest of the subject matter. His "Sources of Information" is a valuable list of periodicals and books.

In the consideration of each group and species the same general method is followed. There is a short historical review, a description of the parasite with a statement of its morphology, life history and development, followed by an account of pathology, treatment, prevention and control. It is interesting to note that the spirochaetes are included under the protozoa, although it is apparent that the author does not entirely subscribe to such an allocation. The filterable viruses, Grahamella, Anaplasma and other inclusion bodies, and the Rickettsia-like organisms are discussed in a chapter on "Other Sporozoa, and Obscure or Invisible Parasites." The author is particularly interested in the biology and bionomics of the parasite and the phenomena of resistance and immunity on the part of the host.

The "Introduction to Human Parasitology" is precisely what its title connotes. It is an authoritative survey of the animal parasites of man and of the diseases induced by them.

H. W. STUNKARD

FORTHCOMING ARTICLES IN OTHER JOURNALS

"JOURNAL OF CELLULAR AND COMPARATIVE PHYSIOLOGY" (August, 1936)

C. A. Angerer. The effects of mechanical agitation on the relative viscosity of Amoeba protoplasm.

F. G. Hall, D. B. Dill and **E. S. G. Barron.** Comparative physiology in high altitudes.

E. P. Laug and **R. Höber.** The excretion of bromide, iodide, and thiocyanate by the perfused frog kidney.

D. E. S. Brown and **F. J. M. Sichel.** The isometric contraction of isolated muscle fibers.

G. Saslow. Twitch tension and initial heat in caffeinized frog muscle.

J. H. Bodine and **E. J. Boell.** Respiration of embryo versus egg (Orthoptera).

H. J. Clausen with the assistance of **B. Mofshin.** The effect of aggregation on the respiratory metabolism of the brown snake Storeria dekayi.

"THE JOURNAL OF MORPHOLOGY" (September, 1936)

H. C. Ray. On the venous system of the common Indian rat-snake Ptyas mucosus (Linn.).

C. Hodge, 4th. The anatomy and histology of the alimentary tract of the grasshopper, Melanoplus differentialis Thomas.

K. A. Siler. The cytological changes in the hypophysis cerebri of the garter snake (Thamnophis radix) following thyroidectomy.

R. J. Bailey. The osteology and relationships of the Phallostethid fishes.

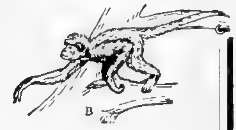
H. L. Eastlick. The effect of fat extraction on Golgi bodies of kidney cells of the frog.

H. T. Anderson. The jaw musculature of the Phytosaur, Machaeroprosopus.

A. C. Scott. Haploidy and aberrant spermatogenesis in a coleopteran, Micromalthus debilis LeConte.

S. M. Das. On the structure and function of the ascidian tezt.

New MACMILLAN Books



Two New Books in the Experimental Biology Monograph Series

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This book is designed to meet the need for a monographic survey of the recent advances which have been made by the method of experimental surgery on the embryo, and their application to an analytical study of this subject. In its fourteen chapters particular attention is given to such significant problems as the factors influencing the proliferation of nerves *in vitro* and *in vivo,* forces influencing the growth of nerve cells within the central nervous system, and the relationship of developing morphological units of the nervous system to general somatic activities. *218 pp., Ill. Cr. 850, $3.75.*

The Eggs of Mammals

By GREGORY PINCUS, *Harvard University*

A concise account of the experimental investigations dealing with the behavior of mammalian eggs during the various stages of their development. A critical account of ovogenesis is followed by an examination of the physiological factors governing the growth, maturation, and atresia of ovarian eggs, and the relation of these processes to the follicular apparatus and the gonad-stimulating hormones of the anterior pituitary. The history of tubal ova is given, with an account of the comparative behavior of fertilized and unfertilized eggs *in vivo* and *in vitro.* An account is given of recently developed techniques for the experimental manipulation of living mammalian ova. *To be published in September. $3.75 (probable).*

Published last Spring: PACEMAKERS IN RELATION TO ASPECTS OF BEHAVIOR, by Hudson Hoagland. *138 pp., Ill., Cr. 800, $3.00*

Projected and Forthcoming Volumes: THE RECEPTOR PROCESS IN VISION, by Selig Hecht; AUTONOMIC NEURO-EFFECTOR SYSTEMS, by W. B. Cannon and Arturo Rosenblueth; PHYTOHORMONES, by F. W. Went and K. V. Thimann; GEOTROPISM: A STUDY OF DETERMINISM IN BEHAVIOR, by W. J. Crozier and Gregory Pincus; THE BIOLOGY AND CHEMISTRY OF OVARIAN HORMONES, by George W. Corner and Willard M. Allen; THE MECHANISM OF HEARING, by Hallowell Davis; BIOLOGICAL OXIDATIONS, by E. S. Guzman Barron; THE HYPOPHYSIS, by J. B. Collip, D. L. Thomson, and H. Selye; NITROGEN METABOLISM IN ANIMALS, by Henry Borsook; TEMPERATURE CHARACTERISTICS, by W. J. Crozier; CYTO-GENETICS AND PLANT PHYLOGENY, by Ernest B. Babcock; BIOELECTRIC PHENOMENA IN PLANTS, by L. R. Blinks; PERIODICITY IN ANIMAL BEHAVIOR, by T. J. B. Stier.

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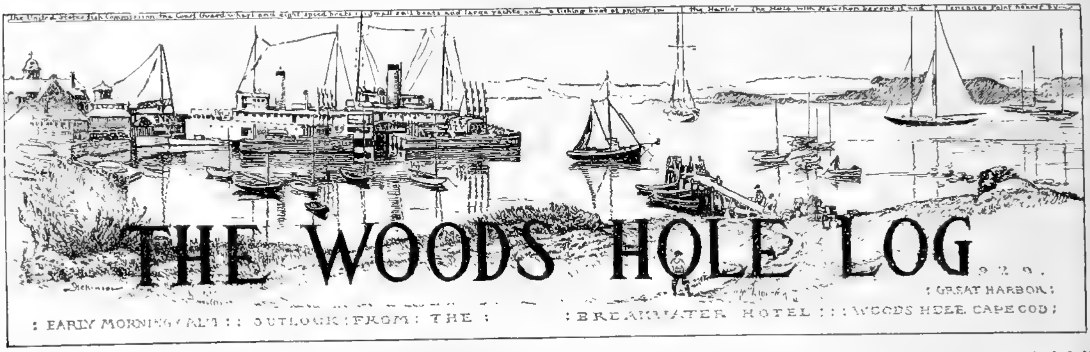

THE WOODS HOLE TRAFFIC PROBLEM

Residents in Woods Hole, particularly business men, have long objected to the parking conditions in the business section of the town. On streets that are at best very narrow, cars are allowed to park for an unlimited period on both sides; as a result the traffic from both directions coming through the main street must share in many cases a single lane.

Our inquiring reporter in sounding out the feeling of some of the business men found that all except one objected very strenuously to parking on both sides of the street; this one man felt that it brought more business to his store but agreed that the danger and inconvenience to general traffic were very great. Most of them objected to having people park their cars in front of places of business while they take long boat trips. Their suggestions are parking on one side only, a town parking place and a limited parking period.

Mr. Dolinsky strongly favors a public parking place; Mr. Cahoon and Mr. Savery, parking on one side only; Mr. Higgins of the Woods Hole Market, a limited period, such as one hour; Mr. Tsiknas, on one side only and for a limited period; the owner of The Twin Door is concerned with the danger of parking on both sides so close to the draw bridge and with motorists who park for long periods in front of the place of business. The Manager of the A & P store, thinks two side parking is dangerous but more convenient to his customers. Mrs. Thompson thinks one-side parking is a practical and a necessary safety measure. Mrs. H. M. Bradford approves of parking on one side; she pointed out how effectively this system worked on Depot Street. *E. T.*

The Editor wouldn't print my communication last week; I was deeply offended. So much so, in fact, that I resolved to cancel my subscription to his magazine. Personally, I think his judgment is not always sound when it comes to his two pages of non-science which I understand his conservative colleagues prefer to call "non-sense." Why, for example, give the chap (or is it a girl) by the name of McInnis—or was it "I'm agin' it"—so much space to ramble along and because of it not print my letters, or other important news that the journal apparently chooses to overlook. I sometimes suspect that the publisher of *The Falmouth Enterprise* has bribed him not to print current events. The former is an astute gentleman! Could it be that he printed that "Stormy Petrel" as a reward for the NET's Editor's policy of "hands-off" interesting news.

When I read that clever set of phrases joined together by fancy words I thought he had paid the *Enterprise* Editor for advertising space (like I'm sure he did last week—something like a dozen dollars, I hear). But I read it a second time and I decided that it was rather derogatory and that if I were he I would get pretty mad.

I almost forgot about the traffic situation! Why does Honorable Harold Baker of the Falmouth Police Department let cars park so close to that corner where Main Street and Railroad Avenue come together by the Woods Hole Market, I wish he could do something about it before the apex of that triangle marks the spot of two battered cars. *—C. N.*

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the Hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
August 10	10:40	11:23
August 11	11:42	....
August 12	12:30	12:41
August 13	1:33	1:46
August 14	2:34	2:42
August 15	3:29	3:38
August 16	4:16	4:27
August 17	4:58	5:10
August 18	5:40	5:57
August 19	6:19	6:39

In each case the current changes approximately six hours later and runs from the Sound to the Bay.

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THE WOODS HOLE LOG

BEACH THEATRE

"Beyond the Terror," a new psychological melodrama with an intriguing metaphysical aspect, will be presented at the Beach Theatre next week, starting August 12. The play was written by Lawrence Terry, author of the daily column "For the Games Sake." It tells of a group of talented and ambitious people gathered at the home of a brilliant physicist. Every person who wished to achieve his goal without a struggle is offered the chance to do so at once. The story of the lives of these people and their ambitions makes an exciting and dramatic play.

The cast which has been in rehearsal two weeks includes Ruth Hammond of last season's prize play, "Winterset," William Post of the cast of "Ah Wilderness," Charles Bryant, leading man for many seasons with Alla Nazimova, Virginia Curley, star of "Personal Appearance" at the Beach Theatre several weeks ago, Guido Nordzo of the cast of "The Vortex" and George Arliss' presentation of the "Merchant of Venice," Garry Mohr, concert pianist, Jeanne Casselle of "Russet Mantle" at the Beach Theatre this season and Albert Hayes, better known as David Garrick of the Lux Radio Theatre program. The play will open on Boardway next season with the same cast.

Rehearsals are well under way for "Crab Apple" the drama to be presented by the Penzance Players on August 25 and 26 at the Community Hall. The author, Theodore Packard, who has worked at the Yale drama school and the Gloucester Little Theatre, is directing the performance. Alfred Compton replaces Thomas Faunce in the tentative cast previously announced.

Tennis Club

Starting Monday, the preliminaries for three tournaments will be in progress under the auspices of the M. B. L. Tennis Club. Men's singles, mixed doubles and women's doubles will be run off.

In the last tournament, Armstrong and Goldin were the cup winners in the men's doubles, Goldin's effective lobbing amusing and interesting the spectators. Miss Robertson is women's singles champion by her victory over Miss Hollingsworth in the finals. Cups were presented to the winners by Dr. Kindred. *E. T.*

If you like to sing songs, old or new, come to the Grammar School on School Street on Wednesday at 8:30 P. M. No charge—just fun. Bring your music if you wish.

Monday Concert

Three artists will be featured at St. Joseph's Church benefit concert to be held in the Marine Biological Laboratory auditorium on Monday night, August 10.

Miss Helen McKenzie, of Woods Hole, will give several violin solos. She was graduated from Falmouth High School with honors last spring. Miss Vilma Fakete Zaroodny, Russian concert pianist, will play two Chopin numbers, "Waltz" and "Mazurka" and a selection by Hubay Love. Baritone Francis J. Burns, Worcester choir leader, will sing a group of negro folk songs. Joseph Nordlow will sing bass baritone.

The auxiliary cutter *Valgerda II* of Huntington, New York, ran aground in the Woods Hole channel last Wednesday evening about 8:30. With the aid of the coast guard and Glendon Hilton, the boat was finally put afloat at 12:05 A. M. Mrs. William Isom is the owner and Elbert C. Isom the master; both are from Garden City, New York.

AUTOMOBILE ACCIDENT ON SIPPEWISSETT ROAD

The illustration shows the skid tracks on the macadam road and the path Dr. Donald K. McClusky's car took when it ran into a telephone post on the edge of the road. The displaced pole is shown and two pictures of the damaged car. Dr. McClusky's head made the hole in the windshield. The accident was described on this page in an earlier number of THE COLLECTING NET.

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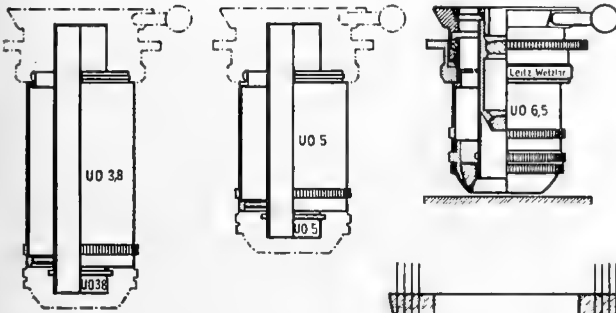

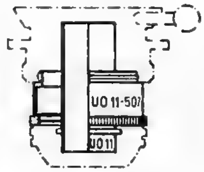

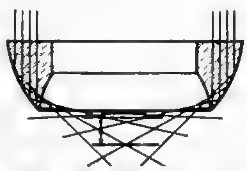

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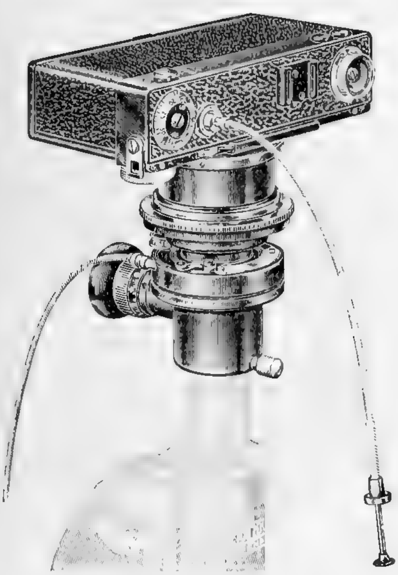

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List of a Few Recent Books

BAUR - FISCHER - LENZ. Menschliche Erblehre u. Rassenhygiene. Band I: Menschliche Erblehre. 1936. ill. 796 pp. $4.97.
EKMAN, Sven. Tiergeographie des Meeres. 1935. ill. 542 pp. $9.36.
FRANZ, Victor. Der biologische Fortschritt. Die Theorie der organismengeschichtlichen Vervollkommnung. 1935. 50 ill. 82 pp. $1.41.
FRENZEL, Gerhard. Untersuchungen ueber die Tierwelt des Wiesenbodens. 1936. 8 ill. 130 pp. $2.01.
HASCHEK, E. u. HAITINGER, M. Farbmessungen. Theoretische Grundlagen und Anwendungen. 6 ill. and 14 tables, 86 pp. (Monographien a.d. Gesamtgebiete der Mikrochemie). 1936. $2.25.
LETTRE, H. u. IMHOFFEN, H. H. Ueber Sterine, Gallensaeuren und verwandte Naturstoffe. 1936. ill. 320 pp. $8.19.
MEHELY, Ludwig. Naturgeschichte der Urbienen. 1935. 60 tables. 214 pp. $9.10.
OPPENHEIMER, Carl. Einfuehrung in die Allgemeine Biochemie. 1936. 227 pp. $5.60.
PASCHER, A. Die Suesswasser-Flora Mitteleuropas. Heft 15: Pteridophyten und Phanerogamen, bearb. von H. Glueck. 1936. 496 pp. $5.70.
REIN, Hermann. Einfuehrung in die Physioologie des Menschen. 1936. ill. 464 pp. $5.72.

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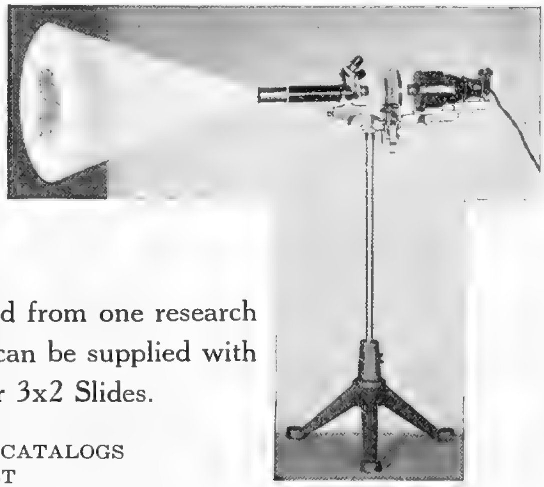

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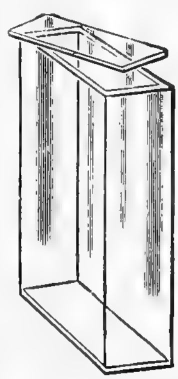

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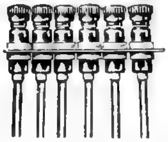

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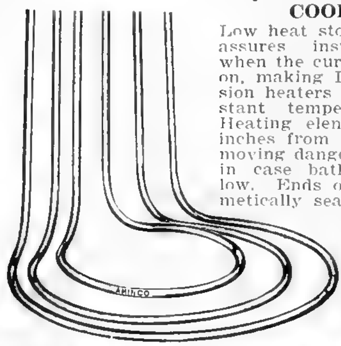

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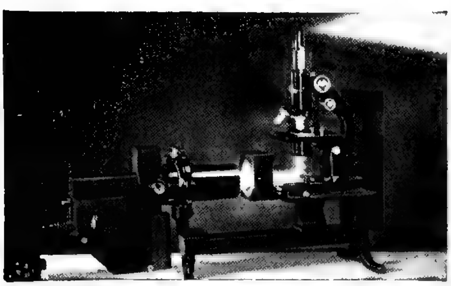

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THE COLLECTING NET

Special Supplement | TUESDAY, AUGUST 11, 1936 | Complimentary

POSSIBLE MEMBERS OF THE CORPORATION FOR THE BOARD OF TRUSTEES

Many members of the Corporation of the Marine Biological Laboratory are eligible for Trusteeship; it seems appropriate at this time to acquaint the members of the Corporation with the accomplishments of certain of their fellow members who are being considered as candidates for election to the Board of Trustees. The brief biographical sketches given, do not, of course, even begin to exhaust the many men who deserve to be honored by trusteeship.

Dr. Henry Bryant Bigelow

Graduating from Harvard in 1901, Dr. Bigelow carried on further studies there and has held various positions at the University, his present title being Curator of Oceanography. His first work was at the Woods Hole Oceanographic Institution.

During the World War, Dr. Bigelow was a reserve officer in the United States Army and served as special expert on the U. S. Shipping Board from 1917 to 1919.

He is a Fellow of the (*Continued on page* 3)

THE ANNUAL MEETINGS OF THE MARINE BIOLOGICAL LABORATORY

For many investigators of the Marine Biological Laboratory, Tuesday is a busy day as three official meetings will convene. In the morning the Trustees of the Corporation elect two new members to their Executive Committee, and the Chairman of their board; they also elect certain investigators at the Laboratory to membership in the Corporation. It is understood that more applications have been submitted for action than is usual.

The Members of the Corporation meet at half past eleven in the morning and when they adjourn, the Trustees are given a special dinner at the Mess Hall. The Trustees will convene again in the afternoon to assimilate the results of the Corporation meeting and to consider any "continued" or "new" business that may be brought before them.

The Corporation meeting promises to be an interesting one and it is unlikely that any member in Woods Hole will absent himself from the Auditorium for the hour around noon. Trustees

M. B. L. Calendar

TUESDAY, August 11, 8:00 P. M.

Seminar: Dr. Laura J. Nahm: "A study of the cells of the adrenal gland of the ewe during estrus and pregnancy."

Dr. E. A. Wolf and Grace Riethmiller: "Studies in calcification: III. The shell of the hen's egg."

Dr. Alexander Sandow: "Diffraction patterns of striated muscle and sarcomere behavior during contraction."

Dr. F. H. J. Figge: "The effect of some oxidation-reduction indicator dyes on the eyes and pigmentation of normal and hypophysectomized amphibians."

Dr. Robert Chambers: "The elimination of neutral red by the kidney tubules."

FRIDAY, August 14, 8:00 P. M.

Lecture: Professor H. W. Stunkard: "Life cycles of digenetic trematodes."

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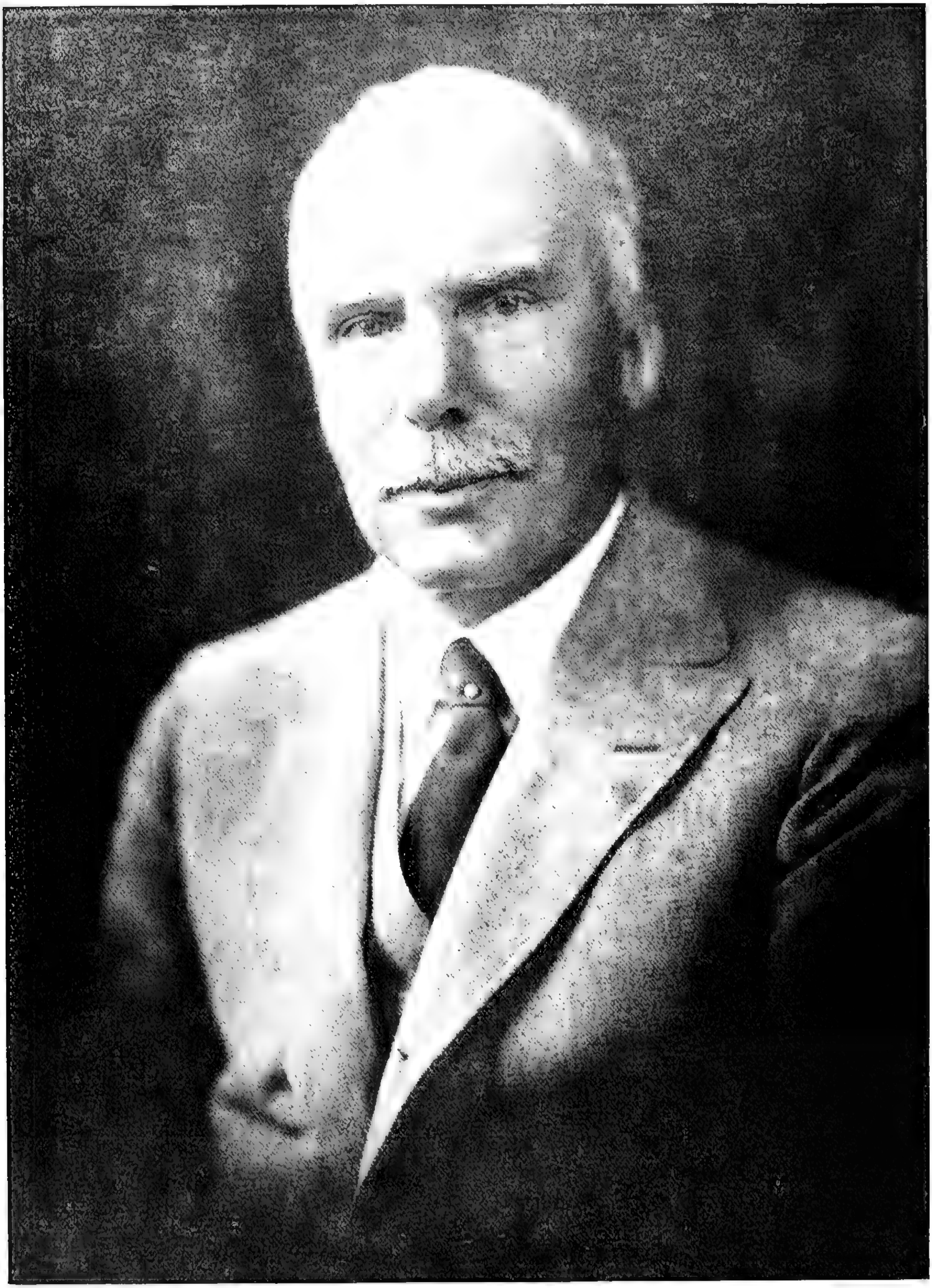

PROFESSOR FRANK RATTRAY LILLIE

Dr. Frank R. Lillie, President of the Corporation and Chairman of the Board of Trustees of the Marine Biological Laboratory. Dr. Lillie's sixty-sixth birthday occurred this year on June 27.

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

ELECTION OF NEW TRUSTEES

It is the opinion of many members of the Corporation of the Marine Biological Laboratory that, in principle, nominations for Trustees of the Corporation should be made by individuals as well as by the nominating committee appointed by members of the executive committee, themselves Trustees. In this way one can be certain that the choice of each Trustee represents the wishes of the majority of the Corporation members; in the past this has not always been the case. Since the officers and trustees of the Corporation are elected by the Corporation members, it should be the duty of each one to encourage the selection of Trustees by vote instead of by appointment. Individual or collective opposition at the meeting to nominations from the floor, such as has exhibited itself in the past, emphasizes the real need for them. The fact that such procedure is frowned upon by influential Trustees is unfortunate. The function of a conscientious nominating committee is to serve in an advisory, rather than in a dictatorial capacity.

If nominations, other than those of the nominating committee, are submitted for consideration at the annual meeting on Tuesday, a loyal member of the Corporation should not vote for an individual for trusteeship *simply* because he was chosen by the nominating committee; if other candidates of worth are presented, they should be considered with the same grace.

Many members of the Corporation, who have not served on the Board, are eligible for Trusteeship. Nominations from the floor are constructive; *they should be a custom, not a novelty.*

RECOMMENDATIONS OF THE INVESTIGATING COMMITTEE

The report of the Committees appointed to study "the matter of the nomination of officers and trustees" of the Corporation of the Marine Biological Laboratory of which Dr. W. C. Curtis was chairman should be in the minds of all corporation members today. They made a thorough study of the situation. Some of their recommendations are here reproduced:

(1) After considering various methods by which those engaged in instruction might be represented upon the Board of Trustees, it is believed that the following action by the Corporation will be the best means of insuring such representation:

"The Corporation affirms its position that instruction is a fundamental part of the work of the Laboratory and hence this work should be adequately represented upon the Board of Trustees."

(2) "That the Committee of the Corporation for nomination of Trustees consist of five members, of whom not less than two shall be non-Trustee members of the Corporation, and not less than two shall be Trustee-members of the Corporation."

(3) "That on or about July first of each year, the Clerk shall send a circular letter to each member of the Corporation giving the names of the Nominating Committee and stating that this committee desires suggestions regarding nominations.

(4) "That the Nominating Committee shall post the list of nominations at least one week in advance of the annual meeting of the Corporation."

(5) "That no trustee shall be elegible for reelection until one year after the expiration of the term for which he was elected."

THE ANNUAL MEETINGS OF THE MARINE BIOLOGICAL LABORATORY

(Continued from page 1)

must be selected by ballot this year, for one or more Corporation members are submitting nominations to Dr. Packard, Clerk of the Corporation, which must be considered by the Corporation as a whole together with the eight candidates sponsored by the Nominating Committee which are: H. B. Bigelow, Robert Chambers, Walter E. Garrey, Caswell Grave, S. E. McClung, A. P. Mathews, C. R. Stockard and Samuel O. Mast. The last-named candidate has been proposed to replace Dr. Greenman who is uneligible for re-election because he has reached the age limit; the Committee recommends that he be made Trustee Emeritus.

A number of desirable candidates made the selection of a successor to Dr. Greenman a difficult one. Dr. Mast was chosen because of his outstanding work in biology, his constant attendance at the Laboratory, and his productivity in graduate students. Someone has stated that Dr. Mast's opposition to certain phases of Jacques Loeb's work explains why the Laboratory has been so long in officially recognizing his accomplishments.

POSSIBLE CANDIDATES FOR TRUSTEESHIP

(Continued from page 1)

American Academy of Arts and Sciences, of the Royal Geographic Society of London and of the Boston Society of Natural History.

Dr. Robert Chambers

Born in Turkey and a graduate of Robert College of Constantinople, Dr. Chambers also studied at Queens College in Kingston, the University of Munich, and has done research work at Columbia University. He has taught in Turkey, at the universities of Toronto and Cincinnati and at the Cornell University Medical School. He is now

research professor of biology at the Washington Square College of New York University.

Dr. Chambers has carried on summer investigations at various laboratories, both on this continent and abroad, but for the most part has devoted himself to experimental work at the Marine Biological Laboratory, first spending a summer here in 1912. He is the recipient of scientific honors in recognition of his research contributions, such as the Traill Medal presented by the Linnean Society of London and the John Scott medal.

Dr. W. C. Curtis

Dr. Curtis, a graduate of Williams College and a former student at the Johns Hopkins University, has been professor of zoology at the University of Missouri since 1908. At Woods Hole he was instructor in the invertebrate zoology course before being elected trustee of the Marine Biological Laboratory in 1923. He was expert witness in 1925 at the Scopes trial in Dayton, Tennessee, chairman of the biological division of the National Research Council, as well as editor of the *Journal of Morphology and Physiology,* and president of the Union of American Biological Scientists.

Dr. Caswell Grave

Studying at the Johns Hopkins University after his graduation from Earlham College in Indiana, Dr. Grave taught zoology there and at Goucher College before transferring to the University of Washington, St. Louis, where he is Rebstock professor of zoology and directs the work of the department. He has also been Director of the United States Bureau of Fisheries Laboratory at Beaufort, North Carolina, and Shellfish Commissioner of Maryland. Dr. Grave has been secretary-treasurer and vice-president of the American Society of Zoologists. He first came to Woods Hole in 1901; beginning in 1912 he was instructor in charge of course work at the Marine Biological Laboratory for seven years.

Dr. W. E. Garrey

Dr. Garrey studied at Lawrence College, the University of Berlin and the University of Chicago. He has held positions in the physiological sciences at Cooper Medical College, Washington University (St. Louis), Tulane University and Vanderbilt University Medical School where he has been professor of physiology since 1925. He has held an instructorship in physiology at the Marine Biological Laboratory since 1924. He is a member of the Physiological Society and the Society of Biological Chemistry. His work has been largely in the field of comparative physiology.

Dr. S. O. Mast

Dr. Mast, professor of zoology at the Johns Hopkins University, first studied at the University of Michigan, Harvard University and at the Michigan State Normal College. He has taught in the field of zoology successively at Hope College, Goucher College, and the Johns Hopkins University. He is on the research staff of the course in invertebrate zoology at the Marine Biological Laboratory of Woods Hole. Dr. Mast is a long time resident of Woods Hole and many of his graduate students have worked here.

Dr. A. P. Mathews

Dr. Mathews, professor and head of the department of physiological chemistry at the University of Cincinnati studied at the Massachusetts Institute of Technology, Cambridge University, the University of Marburg and Columbia University. He has held positions in the biological field at the Massachusetts Institute of Technology, Harvard Medical School, Tufts College, Harvard University, the University of Chicago and the University of Cincinnati where he has been since 1919. He is a member of the Society of Naturalists, Physiological Society and Chemical Society. He was in charge of the work in physiology at the Marine Biological Laboratory from 1904 to 1916.

Dr. Charles R. Stockard

Dr. Stockard, a native of the state of Mississippi, matriculated at Mississippi Agricultural and Mechanical College. He studied, as well, at Columbia University, the University of Cincinnati and at the University of Würzburg. He has held the position of assistant in zoology at Columbia University and has since then been at the Cornell University Medical College where he is now professor and head of the department of anatomy. He is managing editor of the *American Journal of Anatomy* and co-editor of the *Journal of Experimental Zoology.* He is on the Board of Science Directors of the Rockefeller Institute. He has been president of the Society of Zoologists, secretary-treasurer of the Association of Anatomists and secretary of the Society of Naturalists as well as member of the National Academy of Sciences.

Dr. Wm. Randolph Taylor

Dr. Taylor has been professor of botany at the University of Michigan since 1930 and has been in charge of the botany course at Woods Hole since 1919. He received his Ph.D. degree from the University of Pennsylvania in 1920 and taught at that institution for ten years. He has had editorial connections with such publications as *Botanical Abstracts, Biological Abstracts, Stain Technology,* and others.

Dr. Taylor has done research work in cytology; the morphology of chromosomes; algae; marine algae of Florida, the Caribbean, and South America; and fresh-water algae of British Columbia and Newfoundland.

THE COLLECTING NET

Special Supplement THURSDAY, AUGUST 20, 1936 Complimentary

FREIGHTER OF MYSTIC LINE GROUNDED ON GREAT LEDGE

A few minutes after noon on Monday the freighter, *Thomas P. Beal*, grounded on the rocks of Great Ledge about a mile off Juniper Point. A representative of The Collecting Net boarded the vessel six hours later and after being "thrown off" the steamer, the Captain hailed the row boat from Woods Hole which was then pulling away. It returned and the Captain, upon being asked for a statement, made the crisp report "Dense fog; congested traffic; grounded on great ledge at noon." He then courteously explained that he had ordered that no "guests" be allowed on board and stated that any further report must come from headquarters, the Mystic Steamship Company of Boston. He apologised for being able to give our reporter so little information, but said he was quite helpless in the matter. He was in remarkably good humor considering the terrible circumstances in which fate had placed him. In a clean blue shirt, open at the neck, he presented a picture of rugged health and complete self-composure; one immediately felt that he could efficiently command any situation. Outsiders meeting the genial Captain were impressed with his quiet, cultured manner—obviously British-bred—and the cheerfulness with which he faced the difficult situation. The collier was manned by fine men; for example one sailor to whom the reporter talked was a clean-cut Virginian with a cultured southern accent. He had boarded the boat for the first time a few days ago in Norfolk, which is his home town. Of almost massive stature, he made a striking picture; his muscled body, stripped to the waist, was bronzed by the wind and sun; his eyebrows and hair, bleached by the sun, emphasized his darkened skin. It was difficult to reconcile the conflicting pictures, visual and vocal, which presented themselves: a symbol of human power with a characterful face—his deep gentle voice and aristocratic bearing.

A few minutes later a magnificent yacht appeared on the horizon and cautiously approached to within a quarter of a mile of the stranded freighter. A symbol of wealth, colossal in proportions, it was like a great swan with its snowy lines of beauty and majestic grace; dwarfing the rowboat it seemed as king to serf. Imagine the shocked surprise of the inferiority-complexed reporter when, upon daring to approach within hailing distance, a deep voice boomed out asking for information about the freighter and the New York Yacht Club boats which had been racing from Vineyard Haven. The steam yacht was the *Nourmahal* owned by Vincent Astor whose voice it was that questioned the meek and admiring occupants of the flimsy ten-foot row-boat.

The stranded freighter, *Thomas P. Beal*, constructed in 1921, is a steel-plated collier of 250 gross ton displacement with a crew of 34 men. The vessel is about 400 (*Continued on page 2*)

PATRONS AND PATRONESSES FOR "CAPE COD IN COLOR" PRESENTED BY THE COLLECTING NET FOR THE BIOLOGICAL SCHOLARSHIP ASSOCIATION.

As this supplement of The Collecting Net goes to press at nine o'clock on Wednesday evening we are able to report that the following individuals have consented to act as sponsors for the Biological Scholarship Association:

Mrs. B. H. Alton
Mrs. Leroy Clark
Mr. John G. Hutchinson
Mrs. J. R. Jewett
Dr. and Mrs. Alfred Meyer
Dr. Charles R. Stockard

Circumstances have made it so far impossible to consult with more than a few interested individuals and the above names represent only a portion of the sponsors of the colored motion pictures of typical Cape Cod scenes which will be on exhibition in the auditorium of the Marine Biological Laboratory this evening.

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SCHOLARSHIPS IN THE BIOLOGICAL SCIENCES

The Biological Scholarship Association is an outgrowth of THE COLLECTING NET Scholarship Fund which THE COLLECTING NET organized in 1927. Since its foundation in 1926 THE COLLECTING NET has awarded over four thousand dollars in the form of scholarships to young investigators in the biological sciences. In order to insure their permanency, an organization known as THE COLLECTING NET Scholarship Fund Association was initiated, but so that THE COLLECTING NET might at no time be embarrassed by the unfavorable reaction of the trustees of the Scholarship Fund Association toward certain of its independent policies, it was decided that the name of THE COLLECTING NET should not appear in connection with the organization. The new name of the association is The Biological Scholarship Association. Its purpose is to encourage original research in the biological sciences by beginning investigators. The money is given to selected students and research workers of the several marine biological laboratories in the United States to assist them in returning to one of the marine stations the following summer to investigate life processes. The problem under study may be at the moment of purely theoretical interest, but it is often one which has a definite bearing upon the solution of some current medical problem; thus indirectly the scholarships contribute to the maintenance of health and the alleviation of disease.

The annual membership fee is $5.00; other classes of membership will be provided for individuals who care to make a larger contribution. Members will receive not less than four bulletins a year reporting upon the condition of the fund and the work carried out with its assistance. THE COLLECTING NET is undertaking to finance the entire cost of administration so that membership fees can be applied in full to scholarships.

It should be understood that the income from "Cape Cod in Color" or other functions that THE COLLECTING NET will present from time to time are for the benefit of the Biological Scholarship Association, and that in general that it will not be awarded directly for scholarships. It will assist in promoting the objects of the Biological Scholarship Association which is organized so that it can spend no money of its own except to promote research; that is, none of the income from membership fees can be spent on salaries, stationary or other administrative expenses.

The executive committee, which at the moment consists of Dr. Eric Ponder, in charge of the Biological Laboratory at Cold Spring Harbor; Dr. William H. Cole, director of the Mount Desert Island Biological Laboratory; and Professor C. E. McClung, professor and director of the zoological laboratories at the University of Pennsylvania, met on August 11 to draw up a constitution and a set of by-laws, with the latter as chairman. The traveling expenses of the members of the executive committee from out of town are one of the items which must be covered by the income from the various functions that THE COLLECTING NET will present during the month. Another rather large item of expense will be the writing of a number of letters to interested individuals inviting them to join the Biological Scholarship Association.

It is hoped that there will be individuals who will decide that money to promote research work in the biological sciences can be given for the support of the Biological Scholarship Association as well as directly in the form of membership fees. A contribution of $10.00 given in the form of a membership fee will be a contribution of $10.00 to some competent young investigator to assist him in his scientific work. A contribution of $10.00 given for the *support* of the Biological Scholarship Association may reap dividends far greater than $10.00; that is, because of such a gift it would be possible to send more invitations to people to join, to assist in printing a pamphlet reviewing the work of the scholarships which have been awarded during the past nine years and in other ways directly and indirectly encouraging people to join the Scholarship Association.

FREIGHTER GROUNDED ON GREAT LEDGE

(Continued from page 1)

feet long with a 54-foot beam. It is engaged in the North Atlantic coal trade and Mr. R. C. Goodwin reported that she followed no regular route, plying between different ports as occassion arose. On its present trip the *Beal* was carrying 9,500 tons of coal from Norfolk, Virginia to Boston.

The Coast Guard cutters *Colonel Greene* from Woods Hole and *Harriet Lane* from Provincetown, together with the *Algonquin* have been standing by from time to time together with tug boats from Boston. Time and again these rescue vessels have futilly attempted to drag the rock-bound collier from the reef. At eight o'clock last night Mr. Goodwin reported by telephone that the

(Continued on Page 3)

CAPE COD IN COLOR

This Thursday evening, August 20, at 8 o'clock the Marine Biological Laboratory auditorium will be the scene of a gala showing of a moving picture that will be of interest to everyone who has ever had any associations with Cape Cod. Rev. W. J. Miller of Orleans, Massachusetts, will show the moving picture "Cape Cod in Color" which he has taken during the four years that he has lived in this region. The picture will show all the spots of beauty, the places of historic interest and numerous unusual scenes—all typically *Cape Cod.*

The picture includes all the towns along the shore from Provincetown to Yarmouth and Hyannis and Rev. Miller has recently been taking pictures of Woods Hole and its vicinity which will have their premier showing on Thursday evening.

The film begins with some lovely sun-rise shots, then shows all the sights of Provincetown—the most significant city on the Cape—including its monuments, ports, and the oldest windmill on Cape Cod, schools, gardens, churches and many other significant points of interest. One then proceeds down the shore through the various towns, with special attention to the unique and extraordinary qualities that make each one differ from the others, making the sum total of Cape Cod. All the other points of interest are included—with many beach scenes, unusual shots of birds in flight and finally closes with beautiful sunsets.

FREIGHTER GROUNDED ON GREAT LEDGE

(Continued from page 2)

coal was being unloaded on to barges and that he had every hope of successfully extracting the *Beal* intact from Great Ledge shortly after dinner today (Thursday). THE COLLECTING NET hopes to be able to print two or three pictures of the episode in one of its next issues.

The cause of the accident seems difficult to ascertain, but a combination of circumstances—beyond the control of the captain—certainly played a large part in bringing it about. It has been reported by persons who were on the shores near Nobska light that there was a sudden and peculiar formation of dense fog limited to a surprisingly small area. It is thought by many that this circumstance, coupled with the fact, that the waters about were almost clogged with 70 odd visiting yachts and the accompanying boats of many on-lookers, placed the *Beal* in the unfortunate position of having to deviate from the channel to avoid collision with the flocks of smaller craft. The Nobska fog horn was not put into action.

CHORAL CLUB CONCERT: A CRITIQUE

The Woods Hole Choral Club presented its tenth annual concert on Monday evening, before a large and appreciative audience.

The program, in two parts, was unhackneyed and of fine classical character. Mr. Gorokhoff varied his program by an unusual arrangement of the numbers—opening the Sacred Group with a choral from "Die Meistersinger," Wagner, which was followed by "Christus factus est," Anerio (1560-1614), "The Bells of St. Michael's Tower," Stewart, "Of Thy Mystical Supper," Lvoff,—a Russian number of the last century—and closing this group with Handel's "Then Round about the Starry Throne."

Particularly well done was "The Bells of St. Michael's Tower" which showed the basses and tenors to good advantage—and "Of Thy Mystical Supper," performed with beautiful intonation, dynamics and balance.

The second group, consisting of secular songs from early periods of 1238 to the modern 1924, was charming and varied. In this group the altos did some excellent work. The sopranos sang with good quality but lacked volume in *forte* passages.

Margery Mitchell sang the soprano solo in "The Blue Bird," Stanford, with a clear, bell-like voice which shows considerable promise.

A charming number, the early French "Robin Loves Me," Hale, which was done with artistic simplicity, was followed by "The Beetle's Wedding," which was cleverly descriptive of the "buzz" of the beetle in the lower parts, while the sopranos carried the happy tune.—This indeed was a timely place for a light number and was exceedingly well done.

To close the program, the chorus was in its best in "Moon Magic," a Russian folk song, which was lively and harmonically well balanced.—One of the most enjoyable things about the program was the enthusiastic way in which the chorus sang, combined with clear enunciation.

Most of the program was done *a capella*, with good pitch, for which much credit must be given Mr. Gorokhoff for his careful training in such a short length of time.

Woods Hole music lovers have watched, with interest and pride, the growth and progress of a small group to an organization with 41 members, and will look forward to hearing another splendid program next summer.

—BLANCHE HUNTER NELSEN

PENZANCE POINT VS. NAUSHON

On Monday Messrs. Eric and Richard Warbasse were sailing the *Halprev* in a lively breeze in Buzzards Bay when they suddenly caught sight of a floundering "Manchester" similar to their own vessel. Speeding to the scene they arrived in time to rescue Mr. William Forbes of Naushon Island, and two ladies from the choppy waters. The two guests rescued from the sinking *Loon* by the Warbasses were Miss Annie Emerson and Mrs. Burnett.

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Sunday Dinner served from Noon until 8 P. M.

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Special Menus for Luncheon, Bridge and Dinner Parties

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THE COLLECTING NET

Vol. XI, No. 7 — SATURDAY, AUGUST 22, 1936 — Annual Subscription, $2.00 Single Copies, 30 Cents.

THE PLYMOUTH LABORATORY

G. P. Wells
University College, London

The laboratory of the Marine Biological Association of the United Kingdom, at Plymouth, is the chief marine research station in England. It is often regarded as the English homologue of Woods Hole. It is, however, much smaller than the Woods Hole laboratory, from which it differs in several respects.

The original building, now known as the main building, was completed and opened in 1888. It consists of two three-story blocks with a two-story connecting piece between them. One of the end blocks contains a residence for the director and some research rooms. The middle portion houses a large research room for naturalists above, and a public aquarium below. At the other end there are several small laboratories, a workshop, some offices and store-rooms, and living quarters for the engineer-caretaker.

Since the station was first opened, a number of other buildings have been added at various times. They form a group behind the main building. (*Continued on page* 180)

M. B. L. Calendar

MONDAY, August 24, 8:00 P. M.

Lecture: Dr. R. Weissenberg: "The lymphocystic disease of fishes and its significance for intracellular parasitism."

TUESDAY, August 25, 8:00 P. M.

Seminar: Dr. E. Eleanor Carothers: "Cellular behavior in abnormal growths produced by irradiation of grasshopper embryos."

Dr. K. Dan, Mr. T. Yanagita and Mr. M. Sugiyama: "The behavior of cell surface during cleavage."

Dr. T. H. Bissonnette: "Modified sexual photoperiodicity in ferrets, raccoons and quail."

Dr. E. Martin: "Asexual reproduction in **Dodecaceria fimbriatus**."

Mr. G. P. Wells: "Physiology of the stomatogastric system of arenicola."

THE MOUNTAIN LAKE BIOLOGICAL STATION IN 1936

Professor Ivey F. Lewis, *Director*

The buildings of the Mountain Lake Biological Station of the University of Virginia were formally dedicated in July, 1934 in the presence of representatives of many of the Southern colleges. The Station is located one mile north of Mountain Lake in Giles County, Virginia, at an elevation of approximately 4000 feet, on the divide between the Mississippi and the Atlantic drainage areas. In the vicinity is a wide variety of biological conditions varying from peat bogs and cranberry swamps to the dry Alleghany Mountain tops, including mountain and lowland streams and the nearby Mountain Lake, said to be the only natural lake in the Southern mountains and one of the highest in the East.

The buildings are of a rustic type of construction, but provided with electric current and running water obtained by gravity from a spring above the Station on Bear Cliff Mountain. These buildings include the John B. Laing Laboratory, containing four class rooms,

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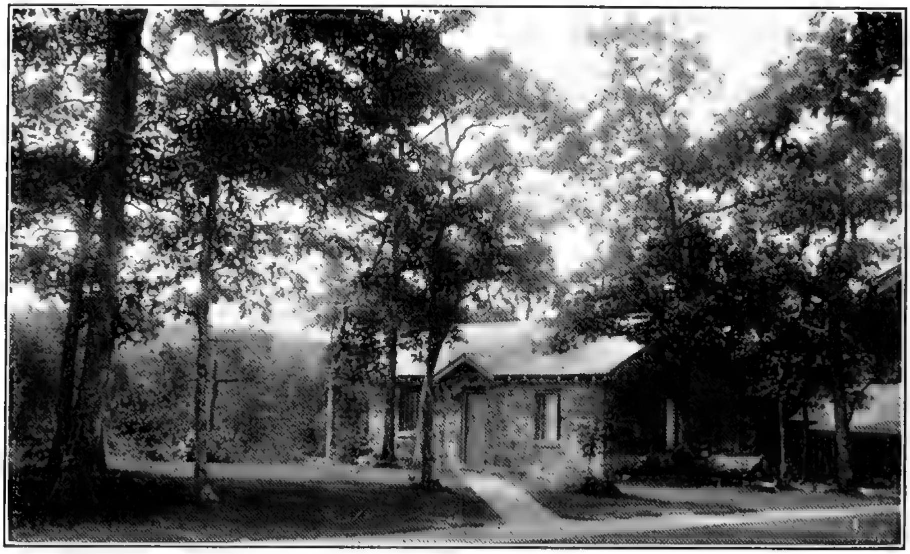
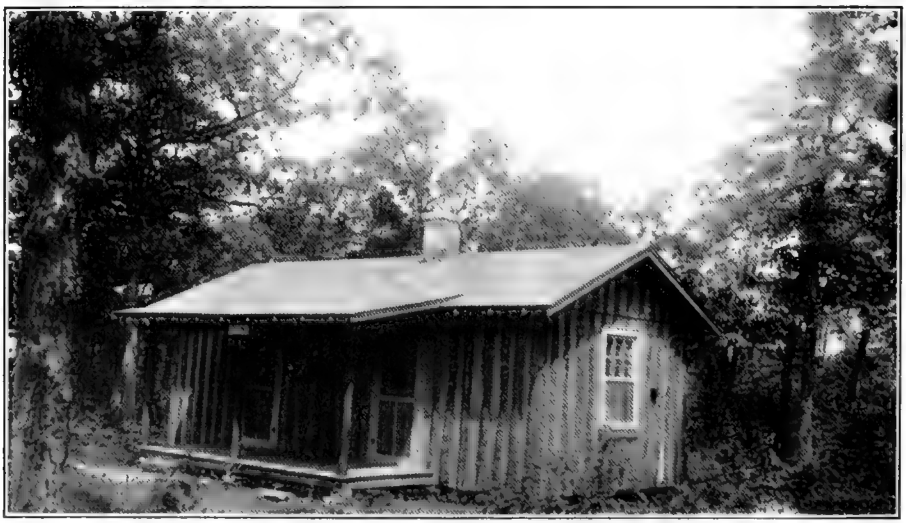


The new library building, Mountain Lake Biological Station.



Catesby Cottage, Mountain Lake Biological Station.

an office, a library and four research rooms. There are also nine residential cottages, a dining hall, two service buildings and garages. Good mountain roads connect the Station with Newport, eight miles away on the main east and west highway into West Virginia and with Pembroke on the Norfolk and Western and Virginian railways. The post office is Mountain Lake, Virginia.

The construction of the buildings was made possible by the gift of 82 acres of land by Mr. John B. Laing of Lewisburg, W. Va., and by a grant from the General Education Board. The Station is expected to serve the Southern states, but it is open to students from other sections.

The completion of three new cottages and of a fireproof library has added much to the comforts and facilities hitherto offered. The library is of native stone and contains work rooms in addition to the reading room. All that is needed now is books and reprints for the shelves.

BRIEF NOTES ABOUT INVESTIGATORS

Dr. Mary S. MacDougall of Agnes Scott College is leaving for Woods Hole after six weeks of research on the cytology and life history of Chilodonella.

The Rhabdocoele group is unusually large this year. Dr. J. W. Nuttycombe of the University of Georgia is completing his monograph on Stenostomum. Dr. Margaret Hess of Judson College, Alabama, and Dr. T. K. Ruebush of the University of Virginia are continuing their investigation of Macrostomum and Dalyellia, while F. F. Ferguson and R. I. Bosman, graduate students, are doing thesis work in the same group.

Dr. H. R. Totten of the University of North Carolina, besides giving the course in Dendrology, has been gathering material for a new edition of Coker and Totten's "Trees of the Southeastern States." He recently found the rare shrub, Buckleya or mountain privet, for the first record in Virginia.

D. R. Hostetter is working out the life history of the junco, which nests abundantly in the vicinity.

Dr. J. Gordon Carlson of the University of Alabama is collecting material for a continuation of his studies on the cytology of grasshoppers.

Andrew L. Ingles is continuing his studies on Blastocladia, a green alga growing on the carapace of the musk turtle. He is spending the next week-end in Washington at the "Zoo," where Dr. Mann, the Director, is permitting him to study similar material in the extensive turtle collection there.

Dr. and Mrs. J. R. Schramm have arrived for a five weeks stay. Dr. Schramm is conducting the seminar on the development of our knowledge of protista, especially those with plant affinities.

Among recent visitors were Dr. and Mrs. Austin H. Clark of the National Museum in Washington and Dr. and Mrs. William Mann of the National Zoological Park. Professors A. B. Massey and A. L. Matthews of the Virginia Polytechnic Institute joined the dendrologists recently for a foray into western Giles County.

Cave enthusiasts at the Station have returned from an exploratory trip into Porterfield's Cave at the foot of the mountain. The animals of the cave were elusive, since neither the cave salamander nor bats, usually common, were seen.

Dr. Thelma Matthews of Coker College has arrived to continue investigation of the Phycomycetes and to give the course on Mycology.

Mary Linda Vardell of Flora MacDonald College is working on the taxonomy of the Compositae of the vicinity.

Samuel L. Meyer of Vanderbilt University has completed a study of the chromosomes of Trautvetteria.

DR. IVEY F. LEWIS

This year Woods Hole had only a brief opportunity to greet Dr. Ivey F. Lewis while he was here for a few days to attend the annual Corporation meeting of the Marine Biological Laboratory. From 1910 to 1927 he was here every summer, first as an instructor and later in charge of the botany course. Since then his summer work has been done at various places and most recently at the Mountain Lake Biological Station where he is director. He is studying a species of Oedocladium found near the Station. This is the first American record west of the Blue Ridge.

Dr. Lewis received his doctor's degree from the Johns Hopkins University in 1908 and for the past twenty years he has been connected with the University of Virginia, at present holding the position of dean as well as professor of biology.

Until July 1 of this year Dr. Lewis was chairman of the Biological Division of the National Research Committee; he has also held offices in the Botanical Society of America, the Union of Biological Societies and other leading biological societies.

Besides his academic achievements, Dr. Lewis has also established himself in the tennis world, having held the Woods Hole tennis championship for a long time. —*U. R.*

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

THE PLYMOUTH LABORATORY

(Continued from page 177)

Of these, the chief ones are a large block equipped for physiological and chemical work, the Allen building housing the library, and a one-room building in which classes are held.

The laboratory stands at the top of the cliffs overlooking Plymouth Sound. The Association owns two collecting vessels which bring in material daily: the *Salpa,* a steam drifter, and the *Gammarus,* a motor boat used mainly for shore work.

When the laboratory was first opened it had a scientific staff consisting only of a Director, a Naturalist, and one scientific assistant. This permanent staff, which is engaged all the year round in research work, has gradually increased until at the present time it numbers twelve. The research programme covers a wide range of problems in marine biology. A great variety of habitats is to be found in the district, including rocky, sandy and muddy shores and waters which vary from the open sea through brackish estuaries to rivers. The fauna of the district is pretty well worked out by now, although research is continuing on such special problems in systematics as the identification of planktonic larvae.

Investigations are also carried out, as part of the regular research programme of the station, on the physics and chemistry of the environment, on plankton numbers and movements and the conditions determining plankton growth, on the biology of food fishes, on the physiology and behaviour of marine animals, on the genetics of Gammarus, and on a variety of other problems that change from year to year. By collaboration between specialists in various fields important contributions are being made to our understanding of the interrelations and life conditions of different types of marine organisms. At present, to take an example, chemists and biologists are combining to study intensively the conditions determining diatom growth and abundance, by integrating the results of plankton counts, analyses of the sea water and of the diatoms, and laboratory culture experiments.

The present Director of the Laboratory, Dr. E. J. Allen, was appointed to his position in 1895. To the great regret of everybody connected with Plymouth, he has announced his intention of retiring this summer. He has been responsible, more than any other single man, for building up the equipment and reputation of the laboratory, and for planning the lines along which the research work has progressed, and he will long be remembered by all who have had the pleasure of working at Plymouth for the real warmth of his welcome to visitors, for his stimulating interest and helpfulness in their work, and for the hospitality with which the resources of the laboratory were placed at their disposal.

The Plymouth laboratory has always been an excellent centre for visiting scientists interested in marine problems, either from other parts of England or from abroad. By Woods Hole standards their number is, however, never great. In the summer there will perhaps be twenty to thirty visitors and at other times there are fewer, although there are usually several visiting workers at all seasons of the year. The laboratory equipment is good for most kinds of work, the collecting boats are well up to their job, and the small size and friendly atmosphere of the station make it a very pleasant place to work in. One soon gets to know everybody—the English afternoon tea, which most people consume daily in the laboratory, being the chief mixing factor—and one has direct access to the supplies of chemicals and apparatus.

For those who do not work twenty-four hours a day there is swimming at the foot of the cliffs on which the laboratory stands, hiking over Dartmoor a few miles away, and splendid walking along the cliffs in both directions from Plymouth. Indeed, the whole of Devon and Cornwall, including some of the loveliest country in England, lies almost at one's feet. Every week in summer the laboratory cricket team takes on, and is defeated by, the team of one or another of the neighboring towns and villages.

The classes are also small by Woods Hole standards. In the Easter vacation there are two consecutive classes in marine biology, each taken by about twenty undergraduate students from different universities. The two classes cover the same ground; they last for about a fortnight and consist mainly of collecting and identifying biological material from different habitats. In addition, there is nowadays an "overflow" class, of the same type, in the late summer. A few years ago, a summer class in Comparative Physiology was given annually by C. F. A. Pantin. This has however now been dropped, as most of the English universities are themselves offering courses of similar scope.

Another important aspect of the activities of the station is the supply of specimens of marine animals and plants to biologists in England and abroad, both for research and for teaching purposes. Expeditions and individual naturalists are also supplied with nets, dredges and other apparatus constructed and tested under the supervision of the staff.

The chief contrast between Plymouth and Woods Hole lies, I think, not so much in the smaller size of Plymouth as in the fact that it is less of a social centre for biologists than Woods Hole. There is usually a pretty large and assorted group of visitors at Plymouth in the summer, but all of them are working on marine material. One does not get the phenomenon, observed here, of workers on fresh-water and land forms, such for instance as Drosophila, moving their material down to a marine laboratory and there pursuing their researches. It should be remembered that Great Britain is a much smaller country than the U. S. A., and that there are numerous societies—the Royal, the Zoological, the Physiological, the Biochemical, the Society for Experimental Biology, the British Association, to mention but a few—that meet in most cases at frequent intervals, in various centres of research. Our distances are relatively short and these meetings are easily accessible; moreover, the numbers of workers in any field is less in Great Britain than in the U. S. A. For these reasons the opportunities for scientific and social intercourse with one's colleagues are greater there than here, and one soon knows and is known by everybody in one's field. The need for a summer meeting place for biologists is therefore not so urgent in Great Britain as it is here.

Those who wish for further information will find a general account of the Plymouth laboratory in the *Journal of the Marine Biological Association of the United Kingdom*, Volume 15, 1928, page 735. Since that account was written, various enlargements and improvements have been made, notably to the library and the physiology laboratory. *The Reports of Council*, which appear annually and are bound up with the *Journal*, will serve to bring this information up to date.

STUDIES IN CALCIFICATION III: THE SHELL OF HEN'S EGG

Dr. E. Alfred Wolf and Miss Grace Riethmiller
Associate Professor of Biology and graduate student, University of Pittsburg, respectively

Last year, at the Marine Biological Laboratory, Dr. McBride and Dr. Wolf reported on our studies of early stages of calcification of bone and teeth in rat embryos. These studies were based on the application of Gomori's modification of the silver nitrate method to calcified tissues. In this method calcium is replaced by black metallic silver; thin sections can be made and striking microscopical pictures result.

The ash of bone and teeth is composed mainly of calcium phosphate (85%) and of about 6% calcium carbonate. It is claimed by Gomori that both phosphates and carbonates react to silver nitrate. On this assumption we came to definite conclusions as to the process of calcification of bone, dentin and enamel formation in teeth. In order to test out the method on calcified structures that are predominantly carbonates, we selected the shell of hen's eggs in which 89-97% is calcium carbonate and only 0.5-5% calcium phosphate.

The eggshell shows three layers: a thin, hard, structureless outer membrane, the main calcareous body and an inner fibrous layer, into which dip the calcified nipples of the main body. Various investigators have stated that the major part of calcium phosphate is deposited at the beginning of the shell formation; it should therefore be found nearest to the fibrous layer. When the shells were taken out of the reagents they were dark on both surfaces showing where the silver nitrate had reacted, but the main body of the shell was untouched: it was still white and hard. Subsequent decalcification caused the now blackened fibrous membrane to slip off the main shell-body. Cross sections through the main part of the shell showed no traces of silver, except for a brown color of the surface membrane. The fibrous membrane under low power magnification had the appearance of a leopard skin: a large number of black spots were more or less evenly scattered over the area of the membrane, the fibers of which were light brown in color. Under high magnification (oil) it could be seen that the spots were due to a precipitation of silver within the fibers themselves. This is taken as an indication of the location of the calcium phosphate deposits in the eggshell.

The failure of the calcium carbonate to react in the case of the eggshell would then suggest that our description of the process of calcium deposition in bone and teeth of rat embryos as it was given last year, was incomplete since it did not include the carbonate portion (6%) of the calcifying structures.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 11).

THE PERMEABILITY OF THE ERYTHROCYTES OF THE GROUND HOG

DR. A. K. PARPART*
Assistant Professor of Physiology, Princeton University

The red cells of the ground hog have been found to be very much more permeable to a variety of dissolved substances than those of any other species thus far examined. The penetration of non-electrolytes from isosmotic solutions was studied by the hemolysis method using photoelectric recording. A few typical results are given below together with a comparison with other species.

Erythritol, in isosmotic solution, penetrates so rapidly that 75% hemolysis requires but six seconds. The erythrocytes of the mouse are the only other cells known to allow a rapid penetration of erythritol, and even in this species over five minutes is required to produce the same degree of hemolysis.

When one examines the penetration of mannitol or sorbitol into ground hog red cells, one finds that these penetrate to the extent observed above in about one minute, while with mouse cells about sixty minutes is required, and no penetration into the highly permeable red cells of man has been observed.

The pentoses, arabinose and xylose, penetrate ground hog cells at such a rapid rate as to produce 75% hemolysis in three minutes, whereas with the cells of man fifty minutes is required and with mouse red cells about six hours.

Glucose, though it penetrates slowly, does cause 75% hemolysis in six hours. Man's red cells most nearly approach this, but here over sixteen hours are required. The apes are the only other species of mammals which are known to have red cells that are at all permeable to glucose.

* Dr. Parpart was a holder of a COLLECTING NET Scholarship during the summer of 1929.

DISCUSSION

Dr. Höber: These are very interesting observations. Only man and ape blood cells have also this permeability to glucose. It seems remarkable to me that in the case of the ground hog permeability runs parallel the molecular volume, whereas in red cells of man and ape the molecular volume rule does not fit at all, since mannitol and other hexites do not enter. The observations on species specific permeability are highly stimulating to find out, inasmuch permeability depends on specific chemical and enzymic properties.

Question: Is there any relation between the systematic position of animals and the permeability of their cells?

Dr. Parpart: It is similar in many respects in the rat and mouse, but man falls into the same category, so that this breaks down.

Dr. Höber: In mice the mannitol enters easily, but glucose not at all—and in others, for instance man and ape, the contrary is true. It is very difficult to explain from any of our present views on permeability.

Question: I would be interested in knowing whether other hibernating animals have been studied?

Dr. Parpart: The groundhogs I studied were not hibernating. No, no other hibernating animals were studied, but I doubt if there is any correlation.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 14).

PHYSIOLOGICAL ADJUSTMENTS TO DIVING IN BEAVER

DR. LAURENCE IRVING
Professor of Experimental Biology, University of Toronto

When a beaver ceases breathing its heart is likewise inhibited. The same response occurs in other diving animals and has been regarded as a means of conservation of the available oxygen. To make the conservation effective adjustments of the peripheral circulation are necessary and evidence for the activity of vasomotor control is presented in rhythmical changes of blood flow through the muscles of the hind leg. The physiological elements which are concerned in respiration appeared during periodic respiration when the cessation of respiration was followed by a slowing of the heart and fall in blood pressure. These changes were synchronous but the synchrony was probably abnormal.

Gentle inflation of the lungs caused a prolonged arrest of breathing movements. With this inhibition of respiration there was associated a fifty per cent. decrease in blood pressure and a great reduction in blood flow through the muscles of the leg. The association of this striking depressor effect with the familiar Hering-Breuer reflex indicates that the stimulus of inflation of the lungs is dominant in controlling the various respiratory adjustments which are essential in diving.

(This paper is based upon a seminar report presented at the Marine Biological Laboratory on July 28).

A POSSIBLE ENDOCRINE ROLE OF THE EOSINOPHIL LEUCOCYTES IN THE FEMALE RAT

Dr. C. P. Kraatz
Assistant in Zoology, University of Cincinnati

Goat anti-rat thymus serum when injected into adult female rats induced endocrine changes corresponding to an increased action of pituitary luteinizing hormone on the ovaries. Pseudopregnancy resulted. Daily injections of ½ cc. of antithymus serum were effective, while single doses of 1½ to 3 cc. at the prooestrous stage of the sexual cycle also evoked this result. Larger doses of control goat serum failed. The invariable accompaniment of pseudopregnancy induced by injections of this serum, primarily hematotoxic in action, was eosinophilia, which was persistent even following single injections.

To determine whether a further correlation existed between luteinizing hormone activity and eosinophil leucocyte concentration in the blood, a series of white cell and differential counts were made on female rats in various stages of sexual activity. The differential determinations of eosinophil percentage were based on counts of 500-1000 stained leucocytes made in a longitudinal direction in the center of the smear to eliminate errors due to inevitable uneven distribution.

The averages for female rats with three different degrees of ovarian activity were:

	Eosinophil leucocytes per c. mm. of blood
Inactive (immature)	59
Active (normal cycles)	325
Hyperactive (cystic ovaries)	666

The adult females showed significant fluctuations within the normal cycles. In pseudopregnancy induced either by sterile copulation at the prooestrous stage or by serum injection at the same stage, the eosinophil concentration was increased over the normal cycle. In all cases, the probable concentration of pituitary luteinizing hormone in the blood was paralleled approximately by the concentration of eosinophil leucocytes.

White blood cell suspensions of varying eosinophil content were compared in their ability to "augment" the action of follicular stimulating pituitary hormone on the immature ovary, a measure of luteinizing hormone. Eleven rats received an average of 2,154,000 eosinophil leucocytes each and demonstrated an average increase in ovarian weight of 148.2% over the ovaries of littermates receiving hormone alone. Nine rats received an average of 513,000 eosinophils per animal, the augmentation here being 39.6%. Thus an increase of 319% in the number of injected eosinophils induced a 274% greater ovarian response. Apparently the luteinizing hormone in the leucocyte suspensions was proportional to the eosinophils present and therefore contained in them.

The eosinophil leucocytes in the female rat conceivably function in the control and transport of the luteinizing hormone of the anterior pituitary gland.

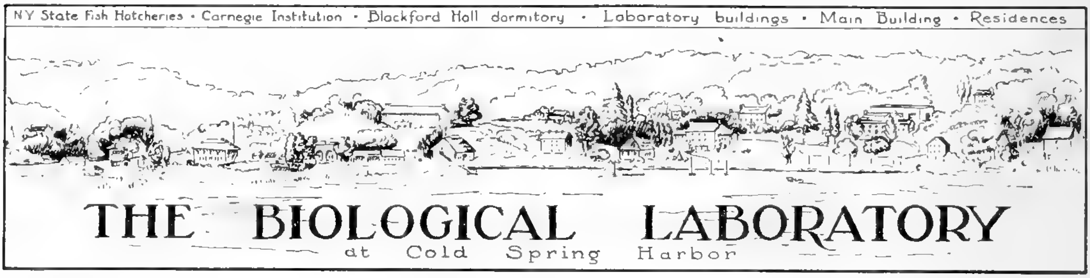
(This article is based upon a seminar report presented at the Marine Biological Laboratory on July 28).

THE RELATION BETWEEN VITAMINS AND THE GROWTH AND SURVIVAL OF GOLDFISHES IN HOMOTYPICALLY CONDITIONED WATER

Dr. Gertrude Evans
Research Assistant in Zoology, University of Chicago

To test whether the growth promoting effect of homotypically conditioned water (water in which other fishes of the same species have lived) was due to vitamins excreted by the conditioning fishes, small isolated goldfishes were fed on vitamin-rich and vitamin-free diets in conditioned and non-conditioned water. The synthetic diet used consisted of casein, starch and salts, with haliver oil, yeast and lemon juice added for the vitamin-rich diet which was also fed to the conditioning fishes. On both vitamin-rich and vitamin-free synthetic diets the fishes grew significantly better and survived longer in conditioned than in non-conditioned water. The two series in conditioned water grew equally well; the two series in non-conditioned water showed equal failure in growth. Better survival of the fishes on the vitamin-rich than on the vitamin-free diet was indicated in both types of water. An assay of fish-conditioned water fed to white rats on vitamin deficient diets showed that vitamins A, B, D and G, if present, were present in very low concentrations. Goldfish apparently can grow for a limited time without vitamins, although growth ceased even in conditioned water after 60 days. Vitamins are not the essential factor in the growth stimulating power of conditioned water.

(This article is based upon a seminar report given at the Marine Biological Laboratory on July 28.)



FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

(Received August 6, 1936)

The courses in Plant Sociology, and Marine and Fresh Water Zoology, began on August 3rd. Dr. and Mrs. H. T. Spieth, Dr. and Mrs. H. J. Van Cleave and Dr. William A. Castle will be here for the duration of the courses.

Dr. Max Poser, of the Bausch and Lomb Optical Company, lectured on the evening of August 4th, on "Scientific Microscopy," the use of Abbé test plates being the basis of his talk.

Dr. and Mrs. Harry Goldblatt, Dr. and Mrs. T. L. Jahn, and Dr. and Mrs. William Cone are at the Laboratory for a few weeks.

Dr. Florence Seibert is here for a short time to work with Dr. Harold A. Abramson.

NOTES FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

(Received August 13)

Drs. A. M. Waterman, K. F. Aldrich, and J. A. Miller, of the Department of Agriculture, are staying at the Laboratory for a few days while carrying on some investigations in the vicinity.

Dr. Hugo Fricke is expected back at the Laboratory in the near future. He has been abroad for several weeks.

Dr. Laurence Moyer has left the Laboratory; he will be married shortly.

Mrs. Samuel Morris, Samuel, Jr., and Margaret, has joined Dr. Morris at the Laboratory for the remainder of the summer.

Mr. and Mrs. Edward Parrish and their daughter, Dorothy, are visiting Dr. and Mrs. J. R. Katz for a few weeks.

Dr. Eric Ponder was at Woods Hole for the Biological Scholarship Association meeting. Dr. David R. Climenko was also at Woods Hole for a few days.

Abstracts of Some Symposium Papers

Dr. Hudson Hoagland: "Some Pacemaker Aspects of Rhythmic Activity in the Nervous System."

Since, in general, physiological rhythms are of the nature of relaxation oscillations, it was assumed that the frequency of such rhythms should be directly proportional to the speed at which critical discharge potentials of the oscillators are built up. Experimental results justifying this assumption were presented. The Arrhenius equation relating chemical velocities to temperature was discussed along with its application to a variety of biological data. Critical thermal increments (μ values) for physiological processes were found to group themselves in certain characteristic modes both for direct chemical determinations of cell respiration and for frequencies of physiological rhythms. These μ values were found to require interpretations in terms of comparatively simple chemical steps which may be regarded as the slowest, or pacemaker, steps in catenary chains of essentially irreversible chemical systems involved in maintaining steady state kinetics in protoplasmic systems. This conception of a pacemaker has not only proved of value in linking together certain biological rhythms with chemical dynamics but, more generally, the temperature method of analysis was shown to be of empirical (taxonomic) value as a way of separating and describing diverse physiological processes. Examples were given showing that, in addition, this type of pacemaker concept is pertinent to psychological and clinical data.

Dr. Herbert H. Jasper: "Cortical Excitatory State and Synchronism in the Control of Bioelectric Autonomous Rhythms."

Bioelectric potentials from the cerebral cortex in man as recorded from the surface of the head and in cats from the surface of the dura, have been studied under various conditions of specific and generalized excitation of the organism. The chronic cat preparation, when free from anaesthesia, restraint, and discomfort, gives autonomous rhythms and reactions to stimulation from various cortical regions similar in almost every respect to those observed in man from the surface of the head. The latencies, magnitude, and duration of the reactions of a given cortical area to ex-

citation through external sense fields are a function of the intensity and duration of the stimulus. The cortical excitatory state is conceived of as a level of polarization of the tissue, which seems to be a major factor in the control of the frequency, regularity, and amplitude of bioelectric autonomous rhythms from cortical ganglion cells. No new mechanisms of reaction peculiar to ganglion cells are necessary in order to explain most of the electrical phenomena observed, since the same type of activity (rhythmicity, increased frequency with catelectrotonus, "on effect," anode depression, cathode blocking of rhythmic discharge, etc.) can be demonstrated in the non-medullated excised peripheral axon. The additional mechanisms of the control of cortical rhythms by periodic external stimulation, together with the complications of synchronism and alternation in the production of potentials led off from a complex group of ganglion cells, are also considered as fundamental mechanisms in determining the observed brain potential rhythms.

BIRD NOTES. III

Song birds are well represented here, with some variations from inland. We miss the indigo buntings and scarlet tanagers, while we are pleasantly surprised to find quail and hermit thrushes. Pine warblers nest in the pitch pines.

The shore birds arrive rather late in the summer. Already noted were two solitary sandpipers (Mashpee) and six turnstones (Nobska). Few species nest here except the spotted sandpiper and more rarely, the piping plover. At many of the islands it is a wonderful sight in the fall to see the large flocks, some of small sandpipers, others of larger ones, and still others of plover.

The marshes have yielded a good crop of black ducks this year.

F. N. Whitman

COLORED MOVIES OF CAPE COD SHOWN

On Thursday evening members of the Woods Hole colony turned out in generous numbers to see the Rev. W. J. Miller's "Cape Cod in Color," and as a result The Collecting Net was able to realize a net profit of $125.00 to be used in administering The Biological Scholarship Association.

Acting as patrons and patronesses of the occasion were Mrs. B. H. Alton, Mrs. LeRoy Clark, Mrs. Murray Crane, Mr. J. G. Hutchinson, Mrs. J. R. Jewett, Dr. and Mrs. Alfred Meyer, Mrs. Seward Prosser, Mrs. Charles Stockard and Mrs. Annie Whittemore.

During the intermission Dr. C. P. Kraatz put up for auction three decorative marine panels in tempora painted by Norris Jones and, though protesting his amateur status in this role, succeeded in keeping his audience delighted and amused in the process of finding purchasers for them.

Mr. Miller's moving pictures dealt with an interesting theme. With but a few exceptions, the shots were clear; and in several instances the composition almost startling in its simplicity and beauty. The unnatural depth of color, caused by focusing the pictures for a screen smaller than is ordinarily used, was not too vivid for enjoyment. On the other hand, the lecturer's running comment left room for much improvement, in the opinion of this department. It seems too bad that such beautiful visual pictures should not be more fittingly accompanied by a richer, more imaginative and more colorful story, especially when there are undoubtedly plenty of people within easy reach of Mr. Miller well equipped to collaborate with him. His moving picture is an artistic accomplishment. The comments, however, could be freshened and enriched by suggestions from someone enthusiastically and imaginatively filled with the lore of this countryside. *J. L.*

OBSERVATIONS ON LENS REGENERATION IN AMBLYSTOMA

Dr. W. W. Ballard

Assistant Professor of Biology, Dartmouth College

In the literature *Amblystoma mexicanum* is said to be capable of Wolffian lens regeneration at all stages in its life history. It is found that *Amblystoma punctatum* loses this ability in late embryonic stages. At stages 38-39, lenses are regenerated very rapidly (4 days) in 100% of the cases. At stage 43, six days later, practically no lens regeneration is obtained. Similar results were gotten from embryos of *A. tigrinum* and *A. microstomum*. During larval stages of *A. punctatum, A. tigrinum, A. microstomum, A. jeffersonianum,* and *A. opacum,* no lens regeneration was obtained over periods up to four months after extirpation. Surprisingly, lens regeneration was found in adult metamorphosed *A. tigrinum* two months after extirpation.

Using uniform material, a greater per cent. of *A. punctatum* embryos regenerated lenses in light than in darkness, at 5°C. than at room temperature, in 6/8 Ringer's solution than in 1/8 Ringer's.

Parabiotic twins were formed in *Amblystoma punctatum* at stages 38-41 in which one lens lay in the pupil between two eyeballs whose irises were superimposed. Of these two eyeballs, the one which had previously been deprived of its lens regenerated a new one, in spite of the presence partly within it of the lens of the other eye.

(This paper is based upon a seminar report presented at the Marine Biological Laboratory on July 21).

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

The date of this issue of The Collecting Net has been altered to correspond more closely with its date of publication. This number is the seventh of the season and chronologically should have been dated August 15. We have done this because of the lateness in publishing this issue, because we wish to include some report of the general scientific meetings to be held Thursday and Friday and because we wish in a later issue to include an account of the meetings of the Genetics Society of American on September 4 and 5.

Introducing

George P. Wells, lecturer in invertebrate physiology at University College, London.

Mr. Wells was born in England and attended the University of Cambridge from which he received his degree. In collaboration with his famous father, H. G. Wells, and with Julian Huxley, Mr. Wells has written, "The Science of Life," a well-known publication both in England and the United States. He is a member of the Advisory Council of the Plymouth Laboratory.

Primarily a scientist, however, he has worked on the action of ions in inverterbrate muscle and water relations of snails and slugs. At Woods Hole he is continuing his work on the nerve physiology of aranicola which he started abroad. He will return to his post at University College in the fall.

Dr. William Walter Cort, head of the department of helminthology at the School of Hygiene and Public Health of the Johns Hopkins University and editor of the *Journal of Parasitology*, is continuing his researches on life cycles of digenetic trematodes at the Michigan Biological Station, Douglas Lake, Cheboygan, Michigan.

Professor J. Kenneth Donahue, head of the department of biology at the College of Charleston is spending the summer at the Bermuda Biological Station where he is endeavoring to determine the presence of estrone in the ovaries of various echinoderms. The extraction work will be carried out at the College of Charleston in the fall with the assistance of Dr. Earl Jennings of the department of chemistry.

In the last issue of *Stain Technology*, Dr. C. E. McClung briefly outlines a new microscopical technique in which the reagent dioxan is used to the exclusion of alcohol and xylol for dehydration, clearing, and as a solvent for sandrac to form a new mounting medium. Formulae are also given for the use of dioxan in fixing fluids, so that this reagent may be utilized at every stage in the technique of making microscopical slides.

K. Richard Johnson, who was a student at Woods Hole in the summer of 1934, is spending this summer in central and northern Europe. He will visit, among other places, such botanical centers as Brünn, Upsala, and Scalöf.

M. B. L. CALENDAR FOR WEEK OF AUGUST 16

Tuesday, August 18, 8:00 P. M.

Seminar: Dr. H. P. Smith and Dr. E. D. Warner: "Quantitative studies on blood clotting."

Dr. Alan C. Burton: "The basis of the principle of of the master reaction in biology."

Dr. C. S. French: "Efficiency of photosynthesis in purple bacteria."

Dr. Alexander Hollaender: "Some effects of ultraviolet radiation on bacteria."

Wednesday, August 19, 8:00 P. M.

Lecture: Dr. J. R. Katz: "Submicroscopical structure of living organs (muscle, etc.) revealed by x-rays."

Friday, August 21, 8:00 P. M.

Lecture: Mr. John Z. Young: "Giant nerve fibres in the squid."

FORTHCOMING ARTICLES IN "THE BIOLOGICAL BULLETIN" (October)

Parker, G. H., The Reactivation by Cutting of Severed Melanophore Nerves in the Dogfish, Mustelus.

Abramowitz, A. A., Physiology of the Melanophore System in the Catfish, Ameiurus.

Zobell, C. E., Observations on the Multiplication of Bacteria in Different Volumes of Stored Sea Water and the Influence of Oxygen Tension and Solid Surfaces.

Coe, W. R., Environment and Sex in the Oviparous Oyster, **Ostrea virginica.**

Koonz, C. H., Some Unusual Cytological Phenomena in the Spermatogenesis of a Haploid Parthenogenetic Hymenopteran, **Aenoplex smithii** (Packard).

Cowles, R. P., and **C. E. Brambel**, A Study of the Environmental Conditions in a Bog.

Trager, W., The Utilization of Solutes by Mosquito Larvae.

Heilbrunn, L. V., Protein Lipid Binding in Protoplasm.

Grafflin, A. L., Renal Function in Marine Teleosts. IV. The Excretion of Inorganic Phosphate in the Sculpin.

Mazia, D. and **Jean M. Clark**, Free Calcium in the Action of Stimulating Agents on Elodea Cells.

Smith, G. M., and C. W. Coates, Cutaneous Melanosis in Lungfishes (Lepidosirenidae).

Program and Abstracts of Scientific Papers*, Presented at the Marine Biological Laboratory.

* 200 to 1000 word summaries of most of these papers can be found in the issues of THE COLLECTING NET for the present summer.

GENERAL SCIENTIFIC MEETING—PRELIMINARY PROGRAM

THURSDAY, AUGUST 27, 9:00 A. M.

F. R. Hunter and *E. N. Harvey*: "The effect of lack of oxygen on the permeability of the egg of *Arbacia punctulata.*"

B. Lucké, R. Ricca and *H. K. Hartline*: "Comparative permeability to water and certain solutes of the egg cells of three marine invertebrates, (Arbacia, Cumingia and Chaetopterus)."

S. A. Corson: "Permeability of *Ameba proteus* to ions."

F. J. M. Sichel and A. C. Burton: "A kinetic method of studying surface forces in the egg of Arbacia."

R. Chambers: "Experimental studies on the oil wetting property of the plasma membrane."

M. J. Kopac: "Interfacial films between oil and cytoplasm."

P. S. Henshaw: "The question of recovery from x-ray effects in Arbacia sperm."

Anna K. Keltch, G. H. A. Clowes and *M. E. Krahl*: "The respiratory effects of certain organic compounds in relation to their molecular structure."

M. E. Krahl, G. H. A. Clowes and *J. F. Taylor*: "Action of metabolic stimulants and depressants on cell division at varying carbon dioxide tensions."

W. C. Allee and *Gertrude Evans*: "Further studies on the effect of numbers present on the rate of cleavage in Arbacia."

A. K. Parpart and *M. H. Jacobs*: "Paradoxical osmotic volume changes in erythrocytes."

M. H. Jacobs, H. N. Glassman and *A. K. Parpart*: "Further studies on specific physiological properties of erythrocytes."

THURSDAY, AUGUST 27, 2:00 P. M.

Demonstrations—to be announced later.

FRIDAY, AUGUST 28, 9:00 A. M.

C. C. Speidel: "Experiments on the contractile substance of muscle fibers."

Elsa M. Keil and *F. J. M. Sichel*: "The injection of aqueous solutions, including acetylcholine, into the isolated muscle fibre."

E. Bozler: "Double refraction of smooth muscle."

F. O. Schmitt, R. S. Bear and *J. Z. Young*: "Some physical and chemical properties of the axis cylinder of the giant axons of the squid, *Loligo pealii.*"

G. Schoepfle and *J. Z. Young*: "Structure of the eye of Pecten."

H. K. Hartline: "The discharge of impulses in the optic nerve fibres of the eye of *Pecten irradians.*"

K. C. Fisher and *J. A. Cameron*: "The effect of light on the CO-poisoned embryonic Fundulus heart."

R. Rugh: "Preliminary evidence as to a source of the growth and the sex stimulating hormones in the bullfrog."

J. A. Cameron and *K. O. Mills*: "Behavior of frog tadpole epidermal cells during seven successive 24 hour regeneration periods."

E. R. Clark and *Eleanor L. Clark*: "Observations on conditions affecting growth of cells and tissues, from microscopic studies on the living animals."

Laura N. Hunter: "Some nuclear phenomena in the Trichodina from *Thyone briareus.*"

S. Hörstadius: "Investigations on determination in the early development of Cerebratulus."

P. B. Armstrong: "Mechanism of hatching in *Fundulus heteroclitus.*"

B. H. Grave and *J. Smith*: "Hermaphroditism and sexual inversion in Mollusca."

Cape Cod is being swept this summer by the biggest vacation boom since 1929, according to reports from Hyannis. Business has taken a great upturn and for rent signs are few and far between.

With the close of the first term Dr. and Mrs. L. L. Woodruff have returned to their home in New Haven en route to Woods Hole. Dr. Woodruff was in charge of the class of twelve graduate students in protozoology.

Dr. Franz Schrader, professor of zoology at Columbia University, will be in Europe during the approaching academic year on his sabbatical leave of absence. Mrs. Schrader, who is teaching in the biology department of Sarah Lawrence College, will accompany him.

Dr. Morton Rubin will be at Clark University as research associate in physiology during the coming academic year.

Summer field courses at the University of Colorado include limnology, ornithology, animal ecology, and field botany. Part of the work is carried on from the campus at Boulder, but most of it is at the mountain laboratory 20 miles up the hill, at an altitude of 9500 feet. Dr. Gordon Alexander of the staff is working upon geographical and altitudinal distribution of grasshoppers throughout the state; Dr. Francis Ramaley is engaged in plant ecology studies in the San Luis Valley and in the eastern Colorado sand hills; Dr. Paul Shope is gathering fleshy fungi at various points in the mountains.

Robert F. Pilts, an instructor in physiology at New York University Medical College, is spending the rest of the summer at Tortugas.

ITEMS OF INTEREST

The department of zoology, University of Pennsylvania, has made several additions to its staff. Dr. Phineas W. Whiting, formerly professor of genetics at the University of Pittsburgh, has been appointed associate professor. His wife, Dr. Anna Rachel Whiting, has resigned as head of the biology department, Pennsylvania College for Women. Dr. Alice M. Russell of the Illman School and Mr. Daniel Havris will be instructors for the coming year. Professor B. R. Nebel, plant cytologist, will be working at the laboratory on a Guggenheim fellowship.

Dr. Floyd J. Brinley, assistant professor of zoology at the University of North Dakota, has recently been promoted to associate professor. This summer Dr. Brinley has been working on the transplantation of embryonic eyes of Fundulus to the pericardial sacs of other Fundulus embryos.

Dr. N. Borodin, for some time curator of fishes at the Harvard Museum and a former investigator at the Marine Biological Laboratory, is now associated with the Marine Biological Station of the University of Southern California, where he will continue his studies of the effect of anabiosis on certain fishes of the Pacific waters. He hopes also to finish several papers covering the work done while in the East.

Professsor Ida L. Reveley retired as head of the biology department at Wells College (Aurora, New York) in June and Dr. Eleanor C. McMullen has been promoted to the professorship.

John Fuller, who has been working at the Oceanographic Institution at Woods Hole this summer, has been appointed instructor in anatomy at Clark University. Mr. Fuller was instructor in biology at Sarah Lawrence College during the past academic year.

Dr. Morton Rubin will be at Clark University as a research associate in physiology during the coming academic year.

Dr. Edward DeSamater is assisting in a laboratory in New Jersey this summer. He is to be an assistant at the College of Physicians and Surgeons in New York this winter. His wife, Dr. Arlene Johnson DeSamater is spending the summer with him. In the winter she will assist Dr. Chew at J. H. U.

Mrs. Lester G. Barth has been appointed technician to Dr. Barth who is assistant professor of zoology at Columbia University.

Dr. Percy L. Johnson is teaching zoology at Missouri Valley College, Marshall, Missouri, and is spending the summer at Surry, Maine.

Dr. Robert W. Hegner, professor of protozoology at the Johns Hopkins University, is vacationing in Spain.

Dr. W. Gardner Lynn, an instructor at Johns Hopkins University, is at the university in Jamaica this summer on a grant-in-aid from the National Research Council. He hopes to be in Woods Hole late in August.

Mr. Archibald N. Solberg, who has been working at the Marine Biological Laboratory for several summers, has been awarded a university fellowship. Mr. Solberg is assistant professor at Columbia University.

T. T. Chen is Johnston Scholar at Johns Hopkins University. He will spend the summer and next winter there.

Professor Elbert C. Cole of Williams College and a party of three students are spending the summer in field study in Arizona. Limited collections are being made with emphasis upon the reptiles and amphibians of the region. However, the most important specimen found so far is an Arizona weasel, *Mustela arizoniensis,* a comparatively rare form. The party's base camp is at Flagstaff, Arizona, near where they are planning to stay until about September 1.

Professor A. M. Reese of the University of West Virginia, who has been an investigator at the Marine Biological Laboratory in other years, reports that there has been a complete reorganization in the departments of zoology and botany at his Institution. Besides doing work on his special study on the development of the notochord in the alligator, Professor Reese is acting as chairman of the West Virginia Biological Survey.

Dr. Franz Schraeder of the department of zoology at Columbia University will spend his six-month sabbatical leave starting in February on a trip to Mexico and Central America. His wife, Dr. Sally Hughes Schraeder, member of the zoology department of Sarah Lawrence College, has also obtained leave and will accompany him. They plan to do field work and collect coccidae.

Professor Mark T. Crowley, Ph. D., of the biology department of Fordham University, will lead a group to collect small mammals, especially bats, in the Gaspe peninsula. The party will spend a whole month in this activity, beginning August 15.

According to Dr. Edward P. Churchill, professor of zoology, research at the University of South Dakota during the past year, was mainly concerned with the histology of the digestive system of western fox squirrel, the histology of the common toad and hermaphroditic specimens, gross anatomy of the digestive system of a dozen of the common minnows of South Dakota and of the trout perch.

NEW CATALOGUES

NOTE: As an added service to our readers we are inaugurating in this issue the listing of new catalogue of apparatus makers and dealers and the announcement of publications pertinent to the biological sciences.

APPARATUS AND SUPPLIES

Eimer and Amend: Bulletin No. 553—Gramercy One Drop Receptacle, for determination of pH value of one drop of liquid, used with Beckman Glass Electrode pH apparatus. June, 1936.

Clay-Adams Company, Inc.: Catalog No. 67 — "Dustite Steel Display Cabinets" describes cabinets for models, skeletons and other teaching material. Catalog No. 66—"Moulages" concerns models of pathological conditions. March, 1936.

Spencer Lens Company: M 76 — Medical microscopes and accessories, June 1936. D 14—Filmslide projectors only, May 1936. M 43—III Ballastics, June 1936.

Pfaltz and Bauer, Inc.: Catalog on Micro-Balances; describes the various models of analytical microbalances with detailed illustrations. July, 1936.

Barnstead Still and Sterilizer Co., Inc.: "Water Stills," "Solvent Stills," and "Alcohol Concentrators"—catalogs contain complete data with prices.

International Equipment Co.: Bulletin A-1936 — "Conical Heads for International Centrifuges"—all types of centrifuges are described in detail.

Calibron Products, Inc.: Notebook No. 3—"Perspective and Optical Illusions of Depth" (Price, 50 cents, additional copies 30 cents), Gauges of depth, optical illusions, historical notes, perspective methods, object-observer-picture plane relationships, perspective rectification, curved objects and shadows, aerial mapping, projection systems; fully annotated. June 25, 1936.

General Biological Supply House, Inc.: No. 6 — "Turtox Biology Catalog and Teachers' Manual," over 100 pages devoted to information on biological problems of the high school teacher, catalog section contains a selected list of materials for high school biology. August, 1936.

New York Scientific Supply Co.: Supplement D—"American Biological Models," models made a special composition which is tough, light and very durable, for human anatomy, embryology, botany and zoology. February 1, 1936.

Spencer Lens Co.: M 65, 66, 67, 70, 72, 76 and 43-III, K78, D14. These catalogs illustrate and describe microscopes and accessories, and projectors and accessories required for all types of laboratory work.

Harvard Apparatus Co.: "Physiological Apparatus," complete catalog, to be published September 1, 1936.

Bausch & Lomb Optical Co.: E-21—"Photomicrographic Equipment," a 26-page book discussing the factors in photomicrography and illustrating equipments for various purposes; section on the Orthro-Stereo Camera and the Euscope, July, 1936.

D-176—"Medical Microscope," a ten-page folder describing monocular and binocular types of physician's microscopes; June 1936.

D-28—"Colorimeters," this 40-page booklet on colorimetry describes optical measuring instruments for determining the concentration of substances in solution; the Hydrogen-Ion and Biological Colorimeters occupy six pages.

BOOKS AND OTHER PUBLICATIONS

The Macmillan Co.: D-85—"College Texts and Reference Books: Biological Sciences, 1936-37," complete descriptive annual catalogue of books and monographs of interest to students and research workers in the various biological sciences. August 7, 1936.

Oxford University Press: "Catalogue of Oxford Books on Science and Technology," a catalogue of the scientific and technical books published by the Oxford University Press. January, 1936.

INVERTEBRATE ZOOLOGY CLASS NOTES

Now that we are starting in our third week on the course, we feel as though we were seasoned Invertebrates. We have completed a successful all-day collecting trip—to Kettle Cove. Not only was this trip successful from the point of view of specimens obtained, noteworthy of which was the relatively rare starfish Henricia, and the lunch provided by the Mess, but also due to much singing to and from the Cove, with a fine rendition of "Sweet Adeline" on the part of Dr. Matthews. However this trip was marked by a few casualties as practically all the angels fell and one ark capsized.

Having been introduced properly to the lowest phyla of the animal kingdom, we are now ready for the annelid worms, which field will be surveyed by Dr. Sayles, who recently demonstrated to us how the sponge Microciona could regenerate new individuals from one-cell fragments. The coelenterates offered us a number of interesting observations, such as the feeding of the Portuguese-man-of-war. A number of students enjoyed turning the lights off in order to observe the luminescence of the ctenophore, Mnemiopsis.

The dance on Saturday night was a wonderful success and a fitting climax to a week of hard work. Experienced observers thought the entertainer an interesting specimen. The only other nightlife to speak of undertaken by members of the class were occasional trips this week to the Eel Pond to see the swarming of Nereis. Another form of organized recreation which will be indulged in this week will be a softball game, inasmuch as the south side of the lab challenged the north side to a game. Be it noted that half of the north side is composed of girls.

On Sunday the Invertebrates could be seen to scatter all over the Cape and even to take to the sea. A couple of beach parties attracted a number of people; several drove up to Provincetown, and a few could be found very close to Martha's Vineyard much later in the afternoon than many of the Mess-hall customers might have wished.

On the basis of past work we are eagerly anticipating the approaching field trips to Lagoon Pond and to Cuttyhunk, which promise to be even more fruitful than the previous ones—if also somewhat more conducive to sea-sickness.

A Page of New Physiological Apparatus

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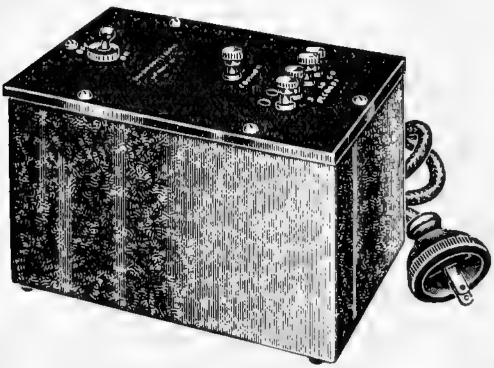

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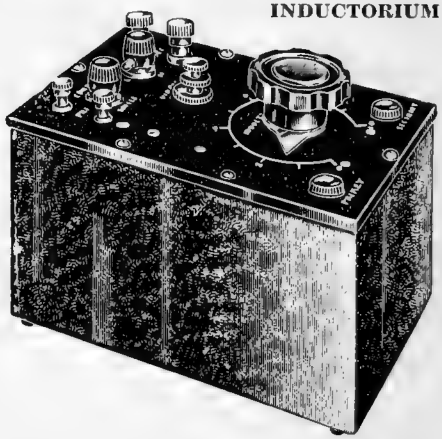

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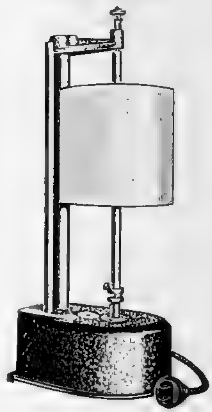

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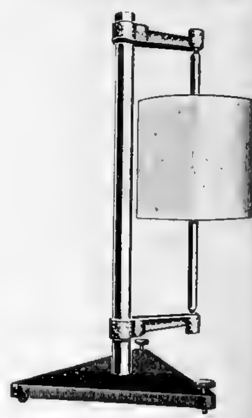

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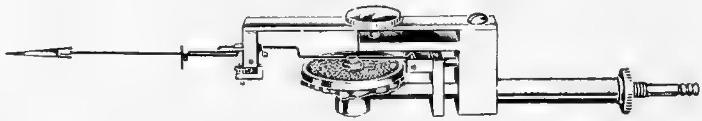

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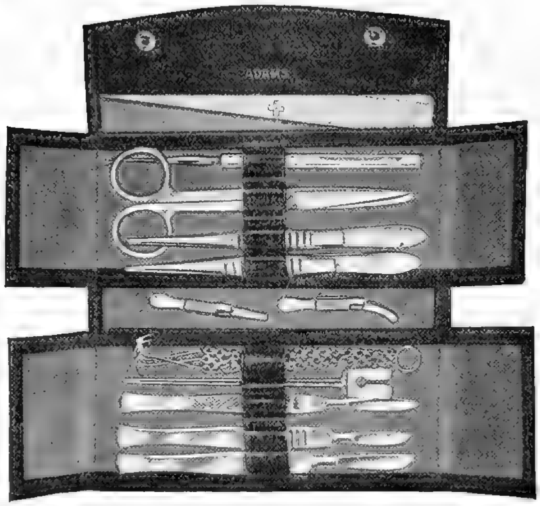

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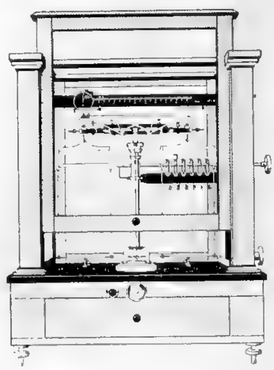

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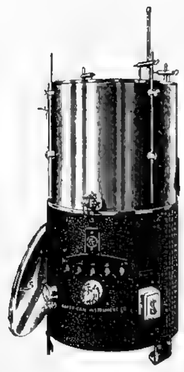

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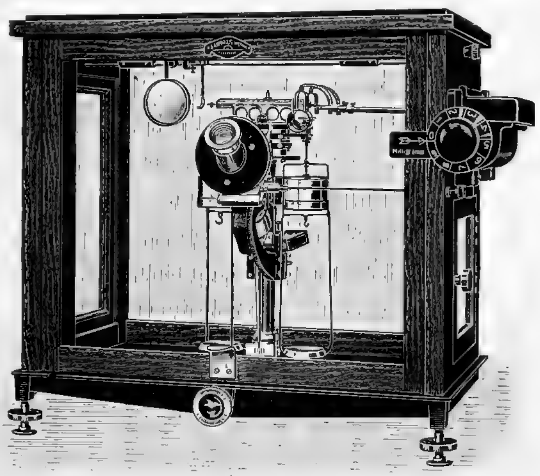

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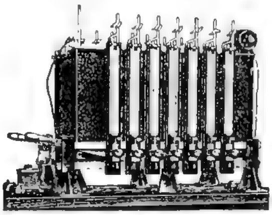

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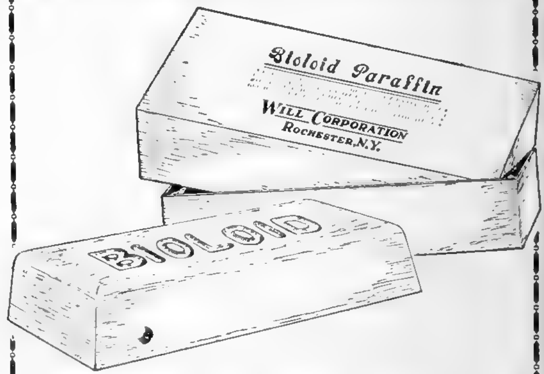

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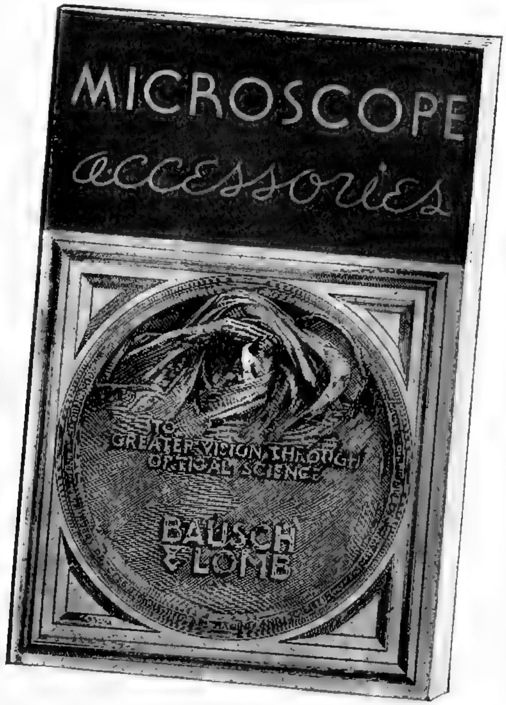

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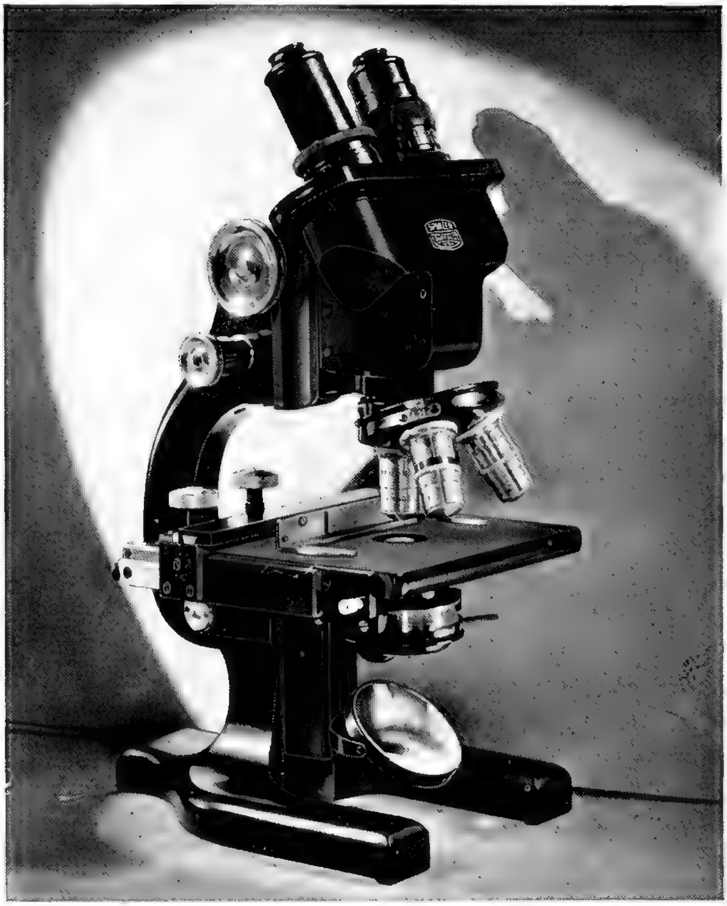

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SOME PROBLEMS IN THE EEL-GRASS SITUATION

Dr. Charles E. Renn

Junior Marine Bacteriologist, Woods Hole Oceanographic Institution
Instructor Harvard University

The recently wasted marine eel-grass, with limited local exceptions has not returned to the degree anticipated by hopeful reports of the past few springs. There are at present few localities along the Atlantic coast where the growth is of immediate significance, but there is undoubtedly an increasing number of new beds discovered each season, and it is from this evidence that the favorable expectations have arisen. Surveying for foliated areas is tedious and unless repeated often through the summer gives a wrong impression of the very unstable condition that prevails in these beds. In some regions, as in the estuaries of eastern Chesapeake Bay, and Shinnecock Bay, Long Island, the grass has persisted through the period of the epidemic. The plants there are not immune varieties; they bear the symptoms of disease and undergo the premature sloughing of leaves characteristic of infected beds. Apparently, favorable environmental factors enable them to maintain a fortunate position in the host-parasite balance.

It is notable that the persisting and returning grass is small, with narrow, relatively short leaves and thin stems. The extreme variation normally shown by the plants under different environmental conditions, makes it (*Continued on page* 200)

CURRENT FISHERY RESEARCH IN AMERICA

Dr. Lionel A. Walford

United States Bureau of Fisheries

Before we can appreciate what fishery researchers are doing in America today, we should look at what they were doing 40 or 50 years ago. This is not very far back, reckoned in terms of the slow tempo of a study that reaches long periods of years into the past or even into the future. Although since that time fishery research has changed its character completely, the popular conception of it has not changed along with it. People still think of a fishery laboratory as a museum or hatchery; this is very much what it was 50 years ago. Having something to do somehow with a natural resource, it was proper in the beginning for fishery students to determine first what this resource was and to try somehow to control its supply. Consequently, the earliest work in America was carried on either in museums, where the taxonomy of the fishes was established, or in hatcheries, which it was hoped might insure a non-diminishing supply of fish. It is interesting, then, that in the *Bulletins* of the Bureau of Fisheries published prior to 1900, 70% of the papers dealt with taxonomic subjects. The first fishery laboratory in America, that at Woods Hole, was in the beginning devoted chiefly to hatchery work.

At the beginning of this century, as the number of available new species diminished and the attention of biologists turned more to experimental work, fishery students extended the scope of their

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THE TRUSTEES OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY, 1936; PHOTOGRAPHED AT THE TIME OF THE ANNUAL MEETING, AUGUST 11.

Back row: C. C. Speidel, Charles Packard, Ivey Lewis, Robert Chambers, S. O. Mast, Franz Schrader, A. C. Redfield, Gary N. Calkins.
Middle row: L. L. Woodruff, D. H. Tennent, W. C. Allee, C. E. McClung, W. R. Amberson, B. H. Willier, F. P. Norton, Caswell Grave, L. V. Heilbrunn, Lawrason Riggs, Jr., E. R. Clark, Laurence Irving, W. E. Garrey.
Front row: A. P. Mathews, Otto Glaser, Ralph R. Lillie, M. J. Greenman, H. H. Donaldson, M. H. Jacobs, Frank R. Lillie, T. H. Morgan, W. B. Scott, E. B. Wilson, Ross G. Harrison, Charles R. Stockard.

work, and began to study the histology, embryology and physiology, not only of fishes but of all other marine organisms as well. The number of taxonomic papers in the *Bulletin* fell between 1900 and 1913 from 70 to 30% to make way for such subjects as histology of the alimentary tract of the squeteague, or behavior of the horseshoe crab under abnormal conditions. In short, the *Bulletin* became a convenient place to publish miscellaneous papers of a marine biological nature. As for hatchery work, it was gradually becoming evident that it was not the cure-all of depletion problems that it was expected to be, and enthusiasm for it was beginning to wane.

In Europe, meanwhile, things had been very different. Europeans had had ample time in which to become scientifically acquainted with their marine resources. Likewise they had been exploiting them for centuries. With the introduction of modern machines into fishing boats, however, the rate of this exploitation accelerated tremendously. Europeans saw the danger of probable depletion, and in practically all the sea-coast countries started intensive studies into the biology of fishes on a scale far larger than is ever applied to most classes of animals.

Although this work began in Europe in about 1880, it did not reach America until about 1913, when the Bureau of Fisheries undertook its Pacific Coast salmon investigations. The improvement in fishing methods, in refrigeration, in canning processes and in rapid transportation, all had been working together to expand the fishing industry into a $60,000,000 business. Since this industry makes use of a public property, it is not merely to the interest of the industry to perpetuate itself, it is more significantly the business of the people to perpetuate its property. Hence government fishery laboratories with extensive programs of study have developed from necessity.

The significant difference between fishery research of 20 or 30 years ago and that of today is this: In the past it generally consisted of a number of disjointed studies made with no long-time program in mind. Now it is concerned with projects of an almost permanent nature. Investigations once started must go on permanently if they are to obtain worth-while results. Thus any work proceeding since the last ten years is "current." It is "current" in the way a stream is. It started somewhere back, goes on before us, and continues on ahead.

The reason for the slow tempo of this work is evident if you consider a typical fishery problem. Here, for example, is a model: We are given a population of aquatic animals (X) in a state of approximate numerical equilibrium. This equilibrium depends on the relation of the population to conditions which have established themselves over a very long period of time, such as the physical environment, the surrounding bios, etc., and on other conditions which vary from year to year, such as the climate. We do not know: (1) How many individuals there are in the population. (2) The birth rate or the death rate (these evidently are not constant from year to year). (3) The exact geographic boundaries of the population. This changes continually from the very beginning of life until the end. Furthermore the population is divided into numerous races which may or may not intermingle.

We now introduce into the situation the following new elements: (a) Large numbers of X's are removed periodically. What is the optimum quantity that may be taken without endangering the safety of the population? How can the victims be selected so as to make this optimum as high as possible? (b) Large quantities of other animals, (Y), on which X feeds, and of others, (Z), which feed on X are periodically removed. These changes are not in direct proportion to those on the X population. The same problems apply here as given under (a). Also, how many Y's and Z's can be removed without adversely affecting the X's?

These are typical fishery problems which are being attacked separately for several species. In the United States and Canada there are perhaps a half dozen organizations engaged in fishery research. The largest of these is the United States Bureau of Fisheries, which is interested mostly in species with interstate distribution. On the Atlantic coast, Bureau investigators are studying chiefly the cod, haddock, mackerel, weakfish, flounder, scup, and oyster; on the Pacific coast, they study the salmon, in the Gulf of Mexico the shrimp, in Alaska the salmon and herring, in the Great Lakes the whitefish and pike perches and in inland streams the trout and bass. These are all long-time projects which have no ending, for as fast as one small sub-problem is solved, another rises to take its place. The principal publications of the Bureau are the *Bulletin*, which contains the works of most lasting and general interest, and the *Reports*, (more recently *Investigational Reports*) which include miscellaneous shorter papers. *Administrative Reports* contain the annual statistics, annual accounts of progress in scientific investigations, and other activities of the various divisions.

The Biological Board of Canada carries on research of a similar nature but on a smaller scale on those species listed above which inhabit Canadian waters. Its chief publications are the *Journal*, which contains articles of a strictly scientific nature and the *Bulletin*, which is designed for the "general fishery public," and which is written in a simpler style than the *Journal*. The Division of Fisheries Research of the Department of Natural Resources of Newfoundland likewise studies the

cod, salmon and haddock and publishes an *Annual Report*.

On the Pacific coast the halibut is a species of great economic importance, which is distributed between the United States and Canada. The International Fisheries Commission has been engaged exclusively in studying this fish for over ten years. The results at irregular intervals are published as *Reports*.

Although most states have fish and game commissions, few have extensive programs of research. California is a notable exception in this respect, having in addition to a staff working on inland fishes, a marine fisheries laboratory. There the Pacific sardine, the tuna, the mackerel, and the flounder are being carefully studied. The scientific results are published irregularly in the *Fish Bulletin*. Michigan maintains an Institute for Fishery Research at the State University, concerned with problems in managing the supply of game fishes. New York is engaged in extensive ecological studies in its streams and lakes. Annual and occasional scientific publications are issued.

The problems which these organizations face are not easy. The methods of attack are indirect and complex, for the events going on in the depths of the ocean are mysterious and to us invisible. Vast quantities of observational data are required that only governmental agencies generally have the facilities for collecting. These agencies are making headway in America and they are succeeding because their purpose is definite. Their work is no longer haphazard but it is organized and planned to be permanent and, what is most important to the people who are paying for it, it is of practical value.

SOME PROBLEMS IN THE EEL-GRASS SITUATION

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impossible at present to ascribe this to true varietal differences in susceptibility—a possibility frequently pointed out. Most of the new plants arise from old stem stock, astonishingly few are derived from seeds of the previous season, though seeds are usually produced.

Explanations of the present epidemic state, now that the extensive wasting has become appreciated, tend toward cosmic causes and are a tribute to the suppleness of human imagination. It seems wisest to look for the most immediate factors first. The symptoms and epidemic spread of the disease suggest microbial parasitism, and a number of searches have been made for microscopic pathogens. Several suspects have been found.

One specific parasitic protozoan, an unidentified Labyrinthula, is universally associated with the disease. It is active chiefly in the leaves of the plant, destroying the chloroplasts and rendering them susceptible to the attack of saprophytes and secondary invaders. This parasite still persists with some local variations in density of infestation over the whole range of the eel-grass' habitat. It is extremely active and may destroy beds within a few days after the symptoms become evident. The Labyrinthula may be found in the small winter leaves of the plant during the cold months, and it may produce slight streaking during this period. But with the warming of the shallow waters in late spring and early summer it becomes very active and affects the premature wasting of the diseased beds. Prolonged cool weather, favorable for the vegetative growth of the plant, inhibits the parasite's development, as does, apparently, the decreased salinities in estuaries.

The changes in shore life dependent on eel-grass are complicated by attending unrelated conditions. This applies, for example, to the scallop which was protected in many regions by dense growths of leaves to which they attached themselves. Sea brant and Canadian geese have not adequately adjusted themselves to the loss of what was formerly their chief winter food and have consequently grown more scarce. Considerable erosion of shallow, muddy bottoms, has followed the disappearance of matted stem stock and roots. New plant and animal associations characteristic of the exposed floors have been developed, often producing a substrate unsuited for the establishment of seedlings.

Barring the miraculous attenuation of the parasite or the natural development of resistant strains —conditions not indicated to date—it is likely that the present equilibrium between the eel-grass and the Labyrinthula will persist. Even under favorable conditions the spread of the beds from existing root-stock is at first very slow; this would apply as well to immune varieties, if such could be found. There is hope that grass from the Pacific coast, where there is no evidence of the disease, may be established on the Atlantic. Several experimental plantings have been made by the U. S. Biological Survey. Several plantations produced seed; thus far there are no symptoms of the disease. Apparently this eel-grass is of a different variety than that found on the Atlantic coast. In the fresher estuaries Ruppia is growing in great abundance in the regions where it was formerly unable to compete with the eel-grass.

(This article is based upon a lecture presented at the Marine Biological Laboratory on July 24).

THE PROGRAM OF SUMMER MEETING OF THE GENETICS SOCIETY OF AMERICA AT THE MARINE BIOLOGICAL LABORATORY, SEPTEMBER 3 - 5

Officers of The Genetics Society of America

President, P. W. Whiting, University of Pennsylvania, Philadelphia, Pa.

Vice-President, L. J. Stadler, Bureau of Plant Industry, U. S. Department of Agriculture, University of Missouri, Columbia, Mo.

Secretary-Treasurer, M. Demerec, Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

Local Representative, B. R. Speicher.

Thursday Evening, September 3, 8:00 P. M.; Auditorium

Marine Biological Laboratory Evening Lecture.

8:00-8:45—Prof. Th. Dobzhansky, California Institute of Technology, Pasadena, Cal. Genetic nature of species differences.

8:50-9:10—Prof. Lee R. Dice, University of Michigan, Ann Arbor, Mich. Some types of waltzing and epilepsy in mice of the genus Peromyscus. (Motion picture).

Friday Morning Session, September 4, 9:30 A. M. Auditorium

Round table conference: Progress in cytogenetics. Leader, Karl Sax, Harvard University, Cambridge, Mass.

Introducers, C. L. Huskins, McGill University, Montreal, Canada and C. B. Bridges, Carnegie Institution of Washington, California Institute of Technology, Pasadena, Cal.

Friday Afternoon Session, September 4, 2:00 P. M., Old Lecture Hall Demonstrations and Exhibits

(1) Anderson, Edgar, Missouri Botanical Garden and Washington University, St. Louis, Mo. Hybridization in Tradescantia.

(2) Baron, A. L. and Powsner, L., First Institute of Podiatry, New York, N. Y. Genetics of bacteria. (1) Preliminary studies on the nature of variation.

(3) Bauer, Hans, Kaiser Wilhelm-Institut für Biologie, Berlin-Dahlem, Germany. Are the chromonemata in salivary gland chromosomes artificial stress-lines?

(4) Bauer, Hans and Th. Dobzhansky, California Institute of Technology, Pasadena, Cal. A comparison of gene arrangement in *Drosophila azteca* and *D. athabasca.*

(5) Bridges, C. B. and G. C. Li, Carnegie Institution of Washington, California Institute of Technology, Pasadena, Cal. Semi-homologous inversions in *Drosophila melanogaster.*

(6) Child, G. P. and T. Albertowicz, Amherst College, Amherst, Mass. The effect of nipagin on the wing size of vestigial of *Drosophila melanogaster.*

(7) Child, G. P. and H. H. Plough. The induction of mutations by high temperature.

(8) Clark, Frank H., University of Michigan, Ann Arbor, Mich. Two hereditary types of hair deficiency in the deer-mouse, *Peromyscus maniculatus.*

(9) Cook, Robert, Journal of Heredity, Washington, D. C. Methods of preparing illustrative material for publications.

(10) Demerec, M., Carnegie Institution of Washington, Cold Spring Harbor, N. Y. A mutability stimulating factor in the Florida stock of *Drosophila melanogaster.*

(11) Dice, Lee R., University of Michigan, Ann Arbor, Mich. Variation in the white-footed mouse *Peromyscus leucopus noveboracensis.*

(12) Eigsti, Orie J., Carnegie Institution of Washington, Cold Spring Harbor, N. Y. Pollen tube studies in Reseda species.

(13) Fankhauser, G., Princeton University, Princeton, N. J. The development of a haploid (merogonic) larva of the Japanese salamander, *Triturus pyrrhogaster.*

(14) Goodale, H. D., Mount Hope Farm, Williamstown, Mass. Evidence that size of headspot (headdot, Keeler) in the mouse is not controlled by modifiers distributed among many chromosomes.

(15) Hoover, Margaret E., Carnegie Institution of Washington, Cold Spring Harbor, N. Y. A case of inversions in tandem in the X-chromosome of *Drosophila melanogaster.*

(16) Kaufmann, B. P., University of Alabama, University, Ala. Chromosome studies on *Drosophila ananassae.*

(17) McBride, T. F., W. J. Harrison, and E. Alfred Wolf, University of Pittsburgh, Pittsburgh, Pa. A contribution to the study of hereditary olidontia in man.

(18) Marshak, A., Deaconess Hospital, Boston, Mass. The structure of somatic chromosomes.

(19) Metz, C. W. and E. Gay Lawrence, Carnegie Institution of Washington, Baltimore, Md. Structure of salivary gland chromosomes in Sciara.

(20) Nebel, B. R. and M. L. Ruttle, New York State Agricultural Experiment Station, Geneva, N. Y. Chromosome structure.

(21) Plough, H. H. and G. P. Child, Amherst College, Amherst, Mass. Specific effects of high temperature in inducing non-inherited variations in *Drosophila melanogaster.*

(22) Plough, H. H. and C. F. Holthausen. High mutation frequency in *Drosophila melanogaster* without environmental change.

(23) Raffel, Daniel, Institute of Genetics, Academy of Sciences, Moscow, USSR. Genes

and the bands of the salivary gland chromosomes of Drosophila.

(24) Scott, Allan C., Union College, Schenectady, N. Y. The unipolar division in Micromalthus.

(25) Steinberg, Arthur G., Columbia University, New York, N. Y. The effect of autosomal inversions on crossing-over in the X-chromosome of *Drosophila melanogaster*.

(26) Warmke, H. E., Seton Hall College, South Orange, N. J. Cytology of the Pacific Coast Trilliums.

(27) MacKnight, R. H., Columbia University, New York, N. Y. Crossing-over in *Drosophila pseudoobscura hybrids*.

Friday evening, September 4, 5:00 P. M.

Excursion of the boat *Winifred* and Clam Bake at Tarpaulin Cove. Boat will sail from the Eel Pond. Swimming for those who desire.

Saturday morning session, September 5, 9:30 A. M.; Auditorium

Round table conference: The nature of mutations.

Leader, R. A. Emerson, Cornell University, Ithaca, N. Y.

Introducers, L. J. Stadler, Bureau of Plant Industry at the University of Missouri, Columbia, Mo. and M. Demerec, Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

PRELIMINARY ANNOUNCEMENT OF THE WINTER MEETING OF THE GENETICS SOCIETY OF AMERICA

The regular winter meeting of the Society will be held with the A. A. A. S. at Atlantic City, December 29 to 31. The tentative program is as follows:

Tuesday, December 29
- Morning and afternoon: Demonstration papers.
- Evening: Biologists' Smoker.

Wednesday, December 30
- Morning: (tentative) Discussion session. Joint session with the American Society of Zoologists.
- Afternoon: Demonstration papers.

Thursday, December 31
- Morning: Round table conference on: "Development of resistant strains in animals and plants." Joint session with the American Phytopathological Society.
- Afternoon: Naturalists' Symposium.

THE BOTANY COURSE

Professor William Randolph Taylor
Director of the Course; Professor of Botany, University of Michigan

It has long been recognized among botanists that a proper professional training involves among other things detailed instruction in the morphology and anatomy of the plants of all classes. In zoology, insects and vertebrates usually receive separate attention, as in botanical schedules do fungi and higher vascular plants. While the writer gathers that in zoological curricula there is little attempt to cover all groups thoroughly, there is in the larger botanical departments a real effort made to avoid neglecting any class of plants. It is relatively easy to do this for plants. The algae are the hardest to provide for. Many are difficult or impossible to preserve in liquid. All lose more or less their essential characters or attractiveness, even if they hold together. However, the rapidly increasing interest in aquatic biology and fisheries, with the fixed recognition accorded to algae as a very important plant group, has caused a continued effort to give courses in the systematic morphology of these plants during the winter, and a recent great increase in the number of summer courses offering similar instruction. In all of these, since they are much less easily treated than that of fresh water, the marine organisms are largely neglected, though the flagellates of both habitats also cause trouble.

It is only at marine stations that instruction in the marine types can be adequately given, because of the perishability of the material. There are few laboratories which attempt it, and but one on each side of the country has been able to do so over a long period of years, for the demands on these stations are heavy and the men free to give advanced instruction in the algae few.

It has been the policy of the Woods Hole staff to treat the group as a whole, irrespective of the marine or fresh water habitat, and it is the peculiar advantage of this station to be able to secure locally representatives of all algae classes, nearly all orders and as many families as the length of the course admits of study. A few of the more striking tropical groups must be studied from preserved material and a few meristematic phenomena from prepared slides, but almost all instruction

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THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

FERTILE EGGS FROM PHEASANTS IN JANUARY BY "NIGHT-LIGHTING" +

Dr. T. H. Bissonnette
Professor of Biology, Trinity College, Connecticut

Increased exposure to light in the long winter season of quiescence activates the sex-glands of juncos, canaries, starlings, crows, doves, mejiros, sparrows, ducks, pheasants, quail, rufted grouse, field mice, ferrets and other animals. But so far Professor L. J. Cole alone seems to have secured fertile eggs from wild birds in this way. Professor H. M. Scott of Kansas was able to induce turkeys to lay fertile eggs in January instead of March, but not guinea fowl. "Night-lighting" is used to obtain more eggs from poultry in autumn and winter for economic reasons.

Pheasants have been induced to lay fertile eggs earlier in spring so that chicks may reach full plumage for liberation well before shooting season opens. Controls were more than 25 pheasants at Shade Swamp Sanctuary, Farmington, Connecticut, confined and fed as usual during the winter and spring. One hybrid ring-necked cock and four hens (*Phasianus colchicus + torquatus*), chosen at random, were kept outdoors in a pen of usual type and fed like controls.

From December 16, they were lighted by a 60-watt bulb for three hours per night for ten days, for four hours for ten days, and for five hours per night thereafter through spring and summer. Both controls and experimental birds received normal light each day.

Controls began to lay first on April 4; many layed much later.

During the first week in January the cock assumed the breeding conditions of head furnishings and plumage and gave the mating call. Copulations began; the first two eggs were laid on January 15; and all four hens were laying before the 25th. Laying reached the rate of about 3½ eggs in 24 hours before January 28 and over 30 eggs were laid before February 3. Laying continued at this rate in spite of severe weather till March 4, when that of one hen became intermittent. She layed at intervals till killed by the cock on April 30 after laying only about 35 eggs.

On April 15, over 240 eggs had been laid—about 30 by the poor layer. So the others laid about 70 eggs each in 91 days or less. Another hen became lethargic and was removed before June 29. On June 25, the three hens had laid more than 316 eggs, over 105 each, and two were still laying intermittently. (Compare with 15-17 eggs laid in the wild; 35-50 laid in not especially lighted captivity).

On February 8, 37 eggs were set and 46 on the 24th, in an improvised electric incubator; but electricity was irregular and no eggs hatched. Of the first 37, 32 were fertile and began development (86.5%). Of the 46, broken at 32 days, 20 still showed unmistakable evidence of development. Six of the first fourteen eggs set under a hen on March 1 were fertile and four hatched at 30 and 33 days; eight out of twelve set on March 20, hatched at 24 and 25 days, instead of the usual 23 days.

At 15 days after hatching, the birds requiring 30 days of incubation were far in advance of those of similar age hatched at 23 days in stage of feathering. So that, while they were delayed in hatching, they appeared to be even in advance of normal in feathering. Some were beginning to assume adult plumage on June 29. This will receive further study.

It has been possible to induce pheasants to lay fertile eggs from January 15 onward (79 days early). By timing the "night-lighting" they may be caused to lay at any desired time after, and probably even before, that date. Percentages of fertility and hatchability were quite satisfactory as compared with normals. Young pheasants from these eggs were reared successfully. Therefore pheasants may be produced in full plumage for release at any desired time in autumn.

+ Aided by grants from the National Research Council, Committee for Research in Problems of Sex, 1935-6, and by cooperation and animals of the Connecticut State Department of Fish and Game. Albert G. Csech supervised the animals and Earl E. Bailey the electrical arrangements.

(This article is a summary of a seminar report presented at the Marine Biological Laboratory on July 21.)

THE MARINE EXPERIMENTAL STATION AT NORTH TRURO

Dr. Frederick S. Hammett

The Marine Experimental Station of The Lankenau Hospital at North Truro is continuing the exploration of the part played by the naturally occurring tissue constituents in developmental growth—the work this season which lasts from May first to October first is confined to study of the reaction of *Obelia geniculata* to aspartic acid—thymine—cytosine—and lysine—the workers in order of seniority are—Miss Nevart Chatalbash—Miss Margaret Elliott—Dr. Theodore Lavine—Marianne Lavine—and Hans Schlumberger. So far the visitors though few have been noteworthy—*viz.* Dr. S. P. Reimann and Dr. F. Bugbee of Philadelphia—Professor Basile Luyet of St. Louis—Professor Otto Glaser of Amherst—and Professor Carl Voegtlin of Washington.

THE BOTANY COURSE

(Continued from page 202)

is given on living or freshly prepared local material. The joining of marine and fresh water types in one course admits of a much more connected account of adaptations and presumed evolutionary grouping. It also permits adequate emphasis of these autotrophic plants as the chief original source of organic material in both fresh and salt waters. While the observations that form the basis of the course are primarily morphological, the plants are studied in entirety and in detail in approximately systematic sequence, for relative unfamiliarity of the students with these plants makes it impractical to group structures and study these in their variations in turn. There is offered considerable opportunity to observe the plants in the field, to collect many kinds and, outside of regular hours, to obtain experience in identification of species in all the large groups. This involves acquaintance with the American and European manuals and monographs most appropriate to our territory. Those students who develop research interests in algae are encouraged to continue in their chosen line here, and given every possible facility to do this.

Dr. William L. Doyle, who received his Ph.D. from the Johns Hopkins University in 1934 has been granted an extension of his Rockefeller fellowship. This year he has been studying in Cambridge, England, but he will continue his work at Copenhagen next winter.

Dr. McKeen Cattell, who was recently appointed professor of pharmacology at Cornell Medical School, is now directing the work of the department.

M. B. L. CLUB NOTES

The annual ping-pong tournament has proceeded to its final stage. In the men's tournament, J. Carmichael and R. Harvey are the finalists.

Programs of phonograph records have been given regularly every Monday and Wednesday evening. Concertos by Bach and Elgar; symphonic excerpts from Wagner; and symphonies by Brahms and Sibelius have been among the recent offerings. The Club wishes hopefully to suggest that music lovers who own any favorite recordings suitable for such concerts would add much to the musical resources of the community if they remember to bring them along when they return to Woods Hole next summer.

Dr. Paul Henshaw, who is a member of the Musicians Society of America, provided an evening of magic on Thursday last and held spellbound an unusually large audience. After his performance there was informal dancing until midnight. The proceeds of the evening's entertainment will be used by the Club to repair a hole in the roof which has been sadly in need of attention for some time now.

The last regular Saturday night dance of the series will take place this evening, with Mrs. Specht as the hostess in charge.

Last Saturday night The Collecting Net sponsored an Old Clothes Party which was, in our opinion, the liveliest party the Clubhouse has seen this season what with a really truly six-piece orchestra and plenty of specialty features.

N. B.: Don't forget it is still possible for people to join the Club this summer. We are anxious to get as many members as possible to cover expenses incurred but not yet met.

W. W. Ballard

A DEMONSTRATION OF THE RESPIRATORY CONTROL OF SEALS

Dr. Laurence Irving

Professor of Experimental Biology, University of Toronto

The seals in the Fisheries pool show an interesting combination of respiratory and cardiac action. Their breathing is irregular and usually occurs, even when they are lying on the float, in alternating periods of breathing and apnoea. When the breathing movements cease, it can be observed that the frequency of the heart beat decreases to about half of the frequency during breathing. These observations can easily be made, for the nostrils close after each inspiration, and the beating of the heart moves the thorax and sometimes the entire seal. When the seals are lying just awash in calm water, the pulsation of the heart will set up a series of small waves on the water surface with each heart beat. As these waves slowly radiate from the seal they form an encircling series of concentric rings. The distance which separates the rings is proportional to the time interval between the heart beats, and closely spaced rings record a rapid, more widely spaced rings a slower beat. In this way the record of the fluctuations in the frequency of the heart beat can be observed on the surface of the water.

Retardation of the heart beat is a regular accompaniment of the interval between breathing movements in beaver, ducks, seals and muskrats. It seems to be controlled in the beaver by inflation of the lungs, and it probably represents the association of cardiac depression with the respiratory inhibition which is an important consequence of the well known Hering-Breuer reflex. The simultaneous inhibition of breathing and heart movements is a significant physiological correlation for diving, but it is probably not peculiar to diving animals. I believe that the factor of cardiac inhibition is only quantitatively more conspicuous in the divers, and that it also occurs to a less noticeable degree in all mammals.

BIOLOGY IN THE COLLEGES

THE TREND OF BIOLOGICAL RESEARCH AT AMHERST

While there is no formulated program of research in biology at Amherst, the activities of the staff lie in the general field of development. Work in genetics, both for its own sake and as a tool for the analysis of developmental and evolutionary processes, is going on under the supervision of Professor Plough and Dr. Child; operative experimentation on the phenomena of induction and regeneration is directed by Professor Schotté; studies on the physics and chemistry of differentiation and growth are supervised by Professor Glaser.

Through cooperation by the Rockefeller Foundation the material needs for these investigations have recently been greatly improved. Added to the accumulated stores of chemicals, glassware, electrical and optical apparatus, some of it not to be found everywhere, we now have a satisfactory animal room, excellent photographic equipment, and a constant temperature room which is a model of its kind.

In addition to the undergraduate assistantships, three graduate assistantships are available. The salaries range from $600 to $1000. The graduates are usually candidates for the Master's Degree which in this department requires two years. Candidates spend most of their time learning how to work. They are permitted to take only two formal cognate courses per year and to participate in a small amount of teaching. Together with undergraduate honors men and staff, the candidates for the M.A. take part in a weekly seminar devoted to the more significant current literature; to problems of general interest; and to work in progress within the department. Library facilities are necessarily limited. Annual departmental expenditure for books and journals is about $1200. These include, in addition to the leading serials in our general sphere of interest, all of the outstanding review journals and most of the major handbooks. Otto Glaser

RESEARCH IN BIOLOGY AT UNION COLLEGE

During the past year biological research has been carried on at Union College by the five faculty members and two graduate students. The researches have been aided by grants from the society of Sigma Xi and the Rockefeller Foundation.

Dr. Ernest E. Dale is continuing his work on variegation and segregation of genetic factors in Petunia and Salpiglossis. He has already discovered a number of segregating factors and an allelomorphic series. Dr. Olive Reese Leonard is cooperating with Dr. Dale in the study of the cytology of the variegations.

Dr. Leonard B. Clark is continuing his work on light reactions in arthropods and is now engaged in a quantitative study of the light reactions of amoeba.

Dr. Samuel Leonard is continuing his work on the endocrinology of reproduction and in this work has been assisted by a graduate student, Mr. Virgil Sager, who also undertook a problem of his own on the effect of endocrines on the rythmical contractions of the uterus of the rabbit.

Dr. Allen B. Scott is continuing the study of some cytological problems arising from one of the most unusual life histories to be found among the insects. A further study is being made of a unipolar spermatocyte "division" and oogenesis in two paedogenetic parthenogenetic larvae of the beetle, Micromalthus.

Under the direction of Dr. James W. Mavor, Mr. Peter Scyjkowski, a graduate student, investigated the variation of the latent period in the contraction of the frog's gastrocnemius muscle.

The results of these investigations were reported at a special meeting under the auspices of Sigma Xi which consisted of short papers and demonstrations by the investigators.

James W. Mavor

Introducing

Professor Richard Weissenberg, formerly extraordinary professor of embryology and microscopic anatomy at the Anatomical Biological Institute of the University of Berlin.

Professor Weissenberg was born in Breslau and attended the Universities of Freiburg and Berlin, receiving his doctorate from the latter in 1906. He was assistant to Professor Oscar Hertwig at the Anatomical-Biological Institute of Berlin for 16 years.

Professor Weissenberg has written a textbook on human embryology from the point of view of comparative embryology, besides some fifty other papers. His research has been mainly in the fields of virus diseases, parasitic protozoa, cytology and embryology.

In the past year he has published two works, researches concerning the schedule of organ rudiments in the embryo of lamprey by the method of localized vital staining (April and July, 1936).

Professor Weissenberg arrived in America on August 8 and he will be in Woods Hole until about Labor Day. His lecture at the Marine Biological Laboratory on Monday, August 24, was on the subject of "The Lymphocystis disease of Fishes and its Significance for Intracellular Parasitism: a Contribution to the Knowledge of the Virus Diseases." Before he sails for Germany on October 10, he plans to visit several of the prominent American universities. *E. T.*

The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

INITIAL GIFT TO SCHOLARSHIP FUND

We consider it a great privilege this week to be able to announce our first gift of twenty-five dollars to finance the work of The Biological Scholarship Association. The sum was donated by a distinguished medical man who asks that his name remain unknown.

It is our hope that this is the first of many similar donations from people who realize the worth of the program of The Biological Scholarship Association.

GENETICS SOCIETY MEETING

The annual summer conference of the Genetics Society of America will convene in Woods Hole on Thursday, September 3rd. Dr. M. Demerec of the Carnegie Institute of Washington at Cold Spring Harbor, Long Island, has been appointed to arrange the program of scientific meetings and Dr. B. R. Speicher of Columbia, now doing summer work in Woods Hole, is the local representative.

For three successive years, ever since the inauguration of the summer sessions, the Society has chosen to meet in Woods Hole because of the facilities available here and because of the central location between Maine and Long Island where many of the members are stationed. A large representation is expected from Cold Spring Harbor and there are several members who are already summering here. The meetings, ordinarily held during the last week of August, were moved ahead this year so as to allow any members planning to attend the Tercentenary Celebration at Harvard to proceed to Boston from Woods Hole.

The conference will open Thursday evening with two lectures. On Friday morning there will be a symposium. In the afternoon a series of demonstrations will be given in the Old Lecture Hall, the demonstration being a fairly new and more interesting method of presenting material and takes the place of the formal paper. The complete program is found on page 201 of this issue.

Dr. Speicher has planned a beach party for the members Friday night and will take them in the *Winifred* to Tarpaulin Cove for swimming and a clam bake.

NOTES FROM SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received August 22)

Mr. Ursel S. Armstrong, who has been assistant to Director Vaughan in the study of foraminifera since last November, left the Institution on Friday to enter the University of California at Berkeley in graduate study and to be an assistant there in the Museum of Paleontology.

Messrs. John Lyman and Theodore Winnick, assistants in the chemical laboratory for the summer, have returned to the University of California at Berkeley.

Mr. Embert Le Lacheur, U. S. Coast and Geodetic Survey, Division of Tides and Currents, and Mr. Leslie G. Hubert of Santa Ana, were recent visitors at the Scripps Institution.

Prof. R. R. Huestis, Department of Zoology, University of Oregon, Eugene, visited the Institution on Tuesday of last week. Professor Huestis was a research assistant and graduate student here some years ago.

Prof. Leonard Loeb and family returned to the University of California at Berkeley after a summer spent at the Institution.

Prof. T. Buck, Department of Mathematics at the University of California, was a week-end visitor at the Scripps Institution.

Mr. Bradley T. Scheer, assistant and graduate student in the physiological laboratory at Scripps Institution of Oceanography, was married on Friday of last week to Miss Marlin Ray of Hollywood. The young couple are living on the grounds of the Institution.

On Monday evening, August 24, at eight o'clock, Prof. R. B. Cowles, University of California at Los Angeles, will speak in the reading room of the library of the Scripps Institution, on the subject, "Beauty in unexpected places." All interested are cordially invited to attend.

Dr. and Mrs. T. Wayland Vaughan and Miss Caroline Vaughan will be at home on Wednesday afternoon, August 26th, at the Scripps Institution Community House, in honor of the new director, Prof. Harald Sverdrup, Mrs. Sverdrup, and Miss Anne Margarethe Sverdrup, and to introduce them to the members of the Institution and residents of San Diego and La Jolla.

Dr. H. U. Sverdrup of the Geophysical Institute of Bergen, Norway, and Mrs. Sverdrup, stopped briefly in Woods Hole as guests of Dr. and Mrs. Henry B. Bigelow who are living in the DuBois Cottage on Penzance Point. They were on their way to La Jolla, California, where Dr. Sverdrup will take over the duties of director of the Scripps Institution of Oceanography on September 1.

ITEMS OF INTEREST

Dr. E. Loewenstein from Goettingen University, recently gave a demonstration lecture on the newest developments in analytical and micro-balances.

Proffessor H. E. Crampton, head of the zoology department at Barnard College, Columbia University, is at his home in Woods Hole for a short time continuing work on his South Sea Islands study. Professor Louise Gregory, also of the zoology department at Barnard College, has been visiting Professor and Mrs. Calkins here for a few days.

Dr. W. O. Nelson, assistant professor of anatomy at Yale University, drove down by automobile last week from New Haven in order to confer with Dr. Edgar Allen, who has spent a large part of the summer here. Dr. Walter Miles, head of the psychology department at Yale, drove up with Dr. Nelson. In the afternoon Drs. Allen, Miles, and Nelson took a sailing trip on Dr. Allen's boat.

Dr. Theodor von Brand will be at the School of Hygiene and Public Health of Johns Hopkins University next fall. He was formerly at the Institute for Tropical Medicine in Hamburg, Germany, and for the past two years he has been working with Dr. August Krogh on metabolism of invertebrates. Dr. von Brand came to the United States in March.

Dr. Serge Morgulis of the faculty of medicine at the University of Nebraska and Mrs. Morgulis recently announced the marriage of their daughter, Edwine, to Monsieur Pierre Racine, "Auditeur au Conseil d'Etat" at Marseilles, France.

Dr. Charles D. Snyder, professor of physiology at Johns Hopkins University, is spending a few days in Woods Hole. He has been busy writing up manuscripts on his experimental studies, he has also just completed a statistical study on the Olympic Games which will be of much general interest.

Dr. and Mrs. Melvin Knisley will sail on the *S. S. American Banker* for London on September 18. Dr. Knisley, who is a fellow of the Rockefeller Institute, will work under Dr. August Krogh, 1920 Nobel Prize winner, at the Institute of Physiology, Copenhagen, in the field of experimental physiology.

Dr. John Buck, who received his Ph.D. at the Johns Hopkins University in 1936, was in Jamaica this summer on a grant-in-aid from the National Research Council. He is to be at the California Institute of Technology for the winter 1936-7 on a National Research Council fellowship.

Dr. Ruth Stocking Lynch is teaching biology at the Maryland State College in Towson, Maryland. She has spent the summer at her home near Baltimore.

INVERTEBRATE ZOOLOGY CLASS NOTES

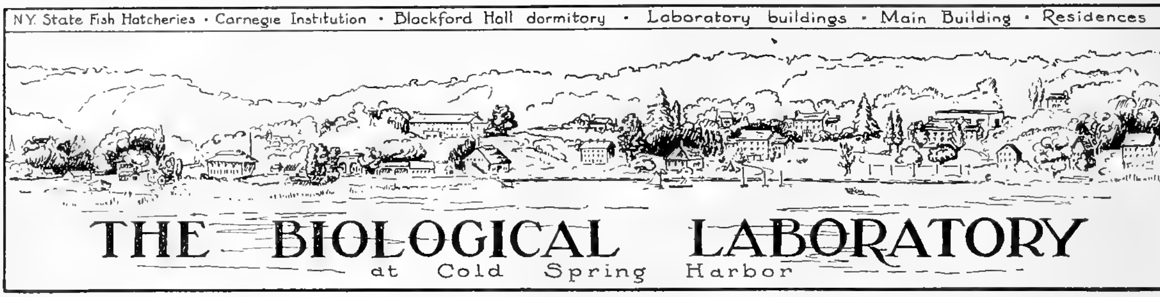
During the last two weeks the invertebrates have been on display. The exhibition of specimens brought back from the Hadley Harbor trip took place in the lobby of the new laboratory building. In spite of competition by the Choral Society in the auditorium, the demonstration was admired by many interested people. It is hoped that the exhibit evoked as much enjoyment in those who observed as it did in those who collected and prepared the material.

Our field trips continue to be successful. The Lagoon Pond trip was even written up for one of the Vineyard papers by a wide-awake, if desperate, reporter. Our recent dredging excursion was noteworthy in that the morning group, collecting in Buzzards Bay, while not returning with many specimens, did bring back all the breakfast it started out with, in spite of very rough weather; the afternoon section, collecting in the Sound, struck better dredging grounds and returned with a good haul. Among the rarer forms were the pelecypod mollusks, Cardium and Pandora. During a recent private collecting trip one of the members of the class found the interesting nudibranch mollusk, Scyllaea, a form seldom reported here in the tide-water zone.

The fracas on the waterfront two weeks ago which was witnessed by a large pre-lecture group was the soft-ball game climaxing a week of heckling between the challenging south-side polychetes and the challenged north-side oligochetes. Though this game was played as much in a marine environment as possible, the oligochetes won by a score of six to one, since which time there has been no talk of soft-ball games. The only casualty was one broken automobile window, smashed by a line drive into left field.

The Invertebrate class entertained at tea one evening last week. The members of the class, seventeen of which wait in the Mess, feel capable of serving tea to their instructors because midnight lunches are now a regular institution—a revival for those spending the night in the lab, and a lure to those desiring to leave at dusk. Any student would say that the instructors and their wives enjoyed the gathering, though it was evident that several were not used to the late hours the students have been keeping. Our next social gathering before the picnic, to which we are eagerly looking forward, will take place during the day time.

David Bishop



FROM THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

(Received August 20, 1936)

MICROSCOPE ILLUMINATION SYSTEMS

At a recent seminar discussion meeting of the Drosophila group at Carnegie Institution, Cold Spring Harbor, the relative merits of various systems of microscope illumination and of available lamps were discussed. Dr. Max Poser of the Bausch and Lomb Company, a student and colleague of Professor Abbe at Jena and long associated with Zeiss, gave an exposition of the optical principles involved in critical illumination for high-aperture condensers and objectives. As a light source for alternating current he recommended a six-volt ribbon-filament tungsten incandescent lamp and for direct current a 110 volt "point-o-light." Both these sources are large in area and uniform in intensity within that area. He emphasized that the lens of the lamp condenser should be of high quality-aspheric to give a flat plane image of the source and achromatic so that the different wave lengths should coincide in focus in that plane. He described the standard "Köhler system" of illumination, which consists in filling the aperture of the condenser (corresponding to the aperture of the objective used) with the image of the light source brought to a focus in the plane of the iris of the substage condenser.

The other speaker was Dr. Calvin Bridges who described the illuminating system developed by himself and contrasted it with the Köhler system. Here the light from the tungsten ribbon is brought to a focus not at the iris of the substage condenser but in air at a position some 30 Cm away from the microscope condenser. In the plane at which a sharp image of the ribbon filament is projected into air an iris diaphragm is mounted. Then the immersed substage condenser is focused so as to project into the plane of the object under examination images both of the ribbon filament and of the circular opening of the closed-down iris.

Dr. Poser commented that this "field-iris" system controls the quality of light in a manner not attainable with the Köhler system, especially in that only useful light is admitted and hence maximum contrast and brilliance without haze are secured for the image under examination. However, for coiled-filament lamps the Köhler system is advisable in order to iron out the inequalities of brightness inherent in the source.

NOTES FROM THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

Dr. Blodwen Lloyd, lecturer in bacteriology at the Royal Technical College, Glasgow, arrived on Tuesday of last week to spend three months' leave from her college work in study in the bacteriological laboratories of the Scripps Institution. After working originally on phytoplankton, Dr. Lloyd turned her attention to bacteriology. She has studied at the Marine Station at Naples, the Marine Station at Plymouth, England, and combines her lecture work at Glasgow with laboratory work at the Marine Biological Station at Millport, Buteshire.

Mr. Horace R. Byers, who recently spent a year and a half at the Scripps Institution working in meteorology with Prof. G. F. McEwen, has received his doctor's degree at the Massachusetts Institute of Technology, and has just been appointed to an instructorship in the U. S. Weather Bureau at Washington, D. C., where his work will be to instruct the employees of the Weather Bureau in modern methods of meteorology.

Dr. R. B. Cowles, Assistant Professor of Biology at the University of California at Los Angeles, will lecture on Monday evening, September 2, at 8:00 o'clock in the library of the Scripps Institution. His subject will be: "Natural history of the South African Bush Veldt." All persons interested in the subject will be welcome.

Dr. B. M. Allen, Department of Zoology, University of California at Los Angeles, arrived at the Scripps Institution on Monday. He expects to use the facilities in the Institution laboratories for research on the physiology of fishes.

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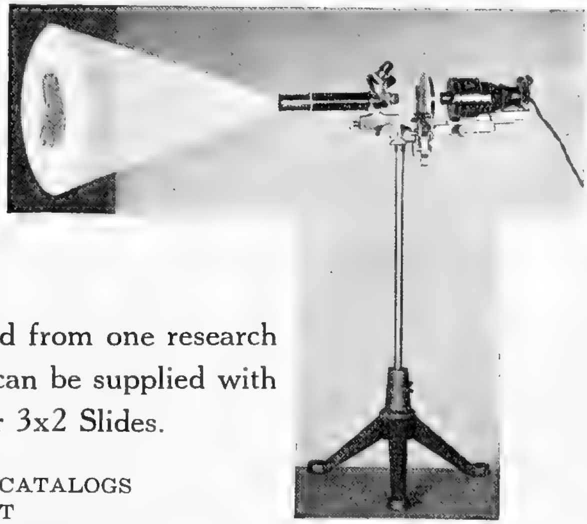

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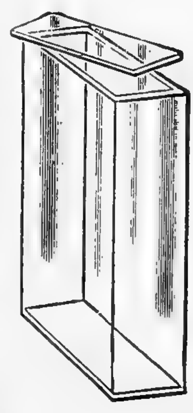

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DEPARTMENT OF PUBLICATIONS

RESUMES OF RECENTLY REVISED BIOLOGICAL TEXTS

COLLEGE ZOOLOGY, R. W. Hegner, Fourth Edition. xvi + 742 pp. 497 illustrations. The Macmillan Company. 1936.
OUTLINES OF GENERAL ZOOLOGY, H. H. Newman, Third Edition. xxvii + 661 pp. 277 illustrations. The Macmillan Company. 1936.
FOUNDATIONS OF BIOLOGY, L. L. Woodruff, Fifth Edition. xvi + 583 pp. 377 illustrations. The Macmillan Company. 1936.
MANUAL OF BIOLOGY, G. A. Baitsell, Fifth Edition. ii + 434 pp. 12 plates. The Macmillan Company. 1936.

A pretty inclusive assembly of zoological pedagogues is watching with interest the Macmillan textbook derby, certainly "run off" impartially, in which are entered the familiar quartet of texts by Baitsell, Hegner, Newman and Woodruff; all these were conditioned and passed under the wire of new revisions last spring. Each is so well known and widely adopted as to require no words of introduction; quite otherwise. So, too, no reviewer may declare any one as especially "superior," for each professor uses that designation for the particular text which chances to parallel his own whims and concepts as to a "best college course."

"With prejudice towards none," a few words may be ventured regarding the main features of the new editions:

"COLLEGE ZOOLOGY"—R. W. Hegner.

The writer indicates his "continued conviction that the method of teaching which directs attention in phylogenetic groups and leads to the deduction of general principles is superior to any other;" and his aim is to present such materials as will be of mutual advantage to a) the many who will take no other zoological courses and b) those who will make biology in some form a life-interest professionally.

The general plan of earlier editions has thus been retained, i.e. a phylum-by-phylum presentation of the animal kingdom, from "lowest" to "highest," largely concerned with structure; with less attention to physiology, embryology, life-histories, and economics, though none of these considerations is omitted. One may question the allotment of 65 pages to protozoa, since this means more than as much as is devoted to platyhelminths arachnids, molluscs and echinoderms combined. The special relation of protozoa to man, of course, helps to justify some of this.

Furthermore, the reviewer seriously questions the value of a "History of Zoology," or of "Palaeontology," when presented in the limits of three pages each.

The postponement of "Heredity and Genetics" to a more posterior portion of the text is doubtless a wise change; many new illustrations have been added and others greatly improved. As a textbook written frankly as an analysis of all the phyla of animals each in its logical turn, Hegner is probably the best available undergraduate text, and the new edition will doubtless gain even wider endorsement than those preceding; and that is saying much.

"OUTLINES OF GENERAL ZOOLOGY"—H. H. Newman.

This text, now metamorphosing on its 12th birthday, comes forth almost as a mutation from its preceding plan of organization and chapter content. The general idea of emphasis on principles, written up from a very broad point of view, —"Life units are put in their cosmic setting"—is continued from previous editions; and, in the reviewer's opinion, is done in most excellent manner.

Presented in six "Parts," the first deals with definitions, problems, nature of materials, values, subdivisions, and history of biology, especially of zoology. Certain persons may easily question whether the student mind so early feels an interest in the history of a field with which he is so slightly familiar. If a story of the evolution of the horse is in the cart, will it not be more interesting after one knows something about the horse in the shafts? However, other excellent texts present similar historical reviews as introductory matter.

The origin, nature, and organization of living substance with its variety and classification (Part II) is followed by a study of representative types for about 275 pages, with a natural and desirable emphasis on the chordates, via the frog (65 pp.). After an excellent resumé of biological mechanisms for maintenance and adjustment, the final section deals with the numerous factors which contribute to an understanding of the most significant of all biological concepts, viz evolution.

The writer has brought to the whole work his usual excellent mastery of narrative, together with a fine sense of pedagogical procedure and philosophical values.

"FOUNDATIONS OF BIOLOGY"—L. L. Woodruff.

This rather unique and very extensively used text now enters on its 15th year. No one can doubt the fitness of its title, or offer more than the least criticism of its remarkable prose composition; and this latter quality is cause for gratitude in any text.

While the subject matter of the main body of the new edition is presented under the same chap-

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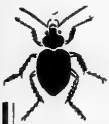
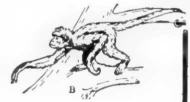


New texts and reference books in the biological sciences



GENERAL BIOLOGY

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and

LABORATORY MANUAL IN GENERAL BIOLOGY

by

J. W. Mavor and L. B. Clark

To be published in September. $1.75 *probable.*

This new text presents a complete course in general biology, covering plants, animals, and general principles. The whole presentation is exceptionally vivid and interesting, with emphasis on the particular importance of the science of biology to man; and is especially well-adapted to the modern general course. One of its special features is the close correlation, in the section on vertebrates, of the study of the anatomy and physiology of the frog with that of man. About a fifth of the entire text is devoted to a clear, well-coordinated study of principles. The Laboratory Manual, to be ready in September, will be a useful adjunct to the text. A wide choice of types is offered, with detailed laboratory directions and sets of printed outline drawings which should considerably increase the efficiency and accuracy of the student's work.

The Living World

By Samuel H. Williams *To be published in the fall*

A pioneer in its field, this book offers for the first time a comprehensive text on nature study suitable for college courses in nature study, field biology, or elementary ecology. The book has been built upon material used in the author's courses given for a number of years at the University of Pittsburgh and is in a very teachable form. The book is fully illustrated, and contains useful appendices.

The Cranial Muscles of Vertebrates

By F. H. Edgeworth $30.00

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The Integration of the Endocrine System

By Sir Walter Langdon-Brown 75¢

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ter titles as used in the preceding edition and chances to cover precisely the same number of pages, scarcely a paragraph has not been somewhat modified, and always, it seems, in the direction of refinement. Not a little new material has been added. Noticeable changes include the following: a) Replacement of Amoeba by Paramecium, as frontispiece; especially in this case, by all means! b) Considerable change from former editions in the discussion of germ cells, development and inheritance. c) The relationships table is less committal to special theory. d) von Haller is added to the portrait gallery and the Comte de Buffon looks out from a new frame. e) Throughout the book the illustrations (increased by 81) have been greatly improved as to size and distinctness (often by redrawing) and by an almost consistent direct labelling of structures with names rather than with letters or numbers referring to explanatory legends. Many thanks for this! f) Two new chapters appear: "Review of the Plant Kingdom," 24 pp.; and "Review of the Animal Kingdom," 55 pp., which, as outlines, leave the instructor free to enlarge on this phase of the subject as much as he likes.

If one is presenting a course in biology, rather than in zoology only, there is plenty of evidence that few texts, if any, have met the approval of as many teachers as has the "Foundation;" the new edition will further prove this statement.

"Manual of Biology"—G. A. Baitsell.

This volume as life-long companion to Woodruff's "Foundations" is also familiar to everyone. Planned primarily as a laboratory guide, it is far more than the terms "guide" or "manual" usually connote.

Preceding the 63 pages of directions for laboratory studies of specific types, tissues and embryological material, are 348 pages of carefully written descriptions of the same things, supplemented by much important ecological information, plus discussions of associations, life-histories and bio-economics.

The new edition has been extensively rewritten, hardly a paragraph remaining as it was in the 4th (1930) printing. A dozen interesting plates have been added and a useful list of reference reading has been appended to each section of descriptive matter. Such an amount of new material has been added that the total book pages have increased from 369 to the above-mentioned 434; the descriptive material is amplified by 120 pages. Insect study now includes the grasshopper as well as the honey-bee; vertebrates receive increased attention, but the echinoderms are not given place; slightly more space is allowed the subject of parasitism, and insects as disease carriers are cited. The laboratory direction pages are no longer perforated and blank pages for notes are not continued.

Again one must state that this book contains as much zoological information as many a treatise which moves under the name of "textbook." The designation "manual," as that term is generally understood, is too modest and inadequate for such a volume as this. R. A. Budington

NEW CATALOGUES

APPARATUS AND SUPPLIES

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256 UV—describes Ubbelohde Viscosimeter — viscosity determinations by the suspended level principle; viscosity readings in centistokes on all mineral oils; accuracy within plus minus 0.1%.

Cat. 4892E—"Jena Colored Optical Filter Glasses," special catalogue describing Jena optical filters; uniform, stable, selective transmission in all regions of the spectrum, full description and transmission values on each type of filter.

Cat. 232LE—"Jena Fritted Glass Filters," catalogue describing the use of fritted glass filters of various types and sizes for all filtration purposes; suggestions for solving filtration problems.

E. Machlett and Son: "S"—Schaerr Heavy Duty Shaker. Describes a new and unusual laboratory shaker, outstanding for its silent operation, adjustability, sturdy construction, low maintenance cost, portability, and self-anchoring characteristics. January 1, 1936.

CURRENTS IN THE HOLE

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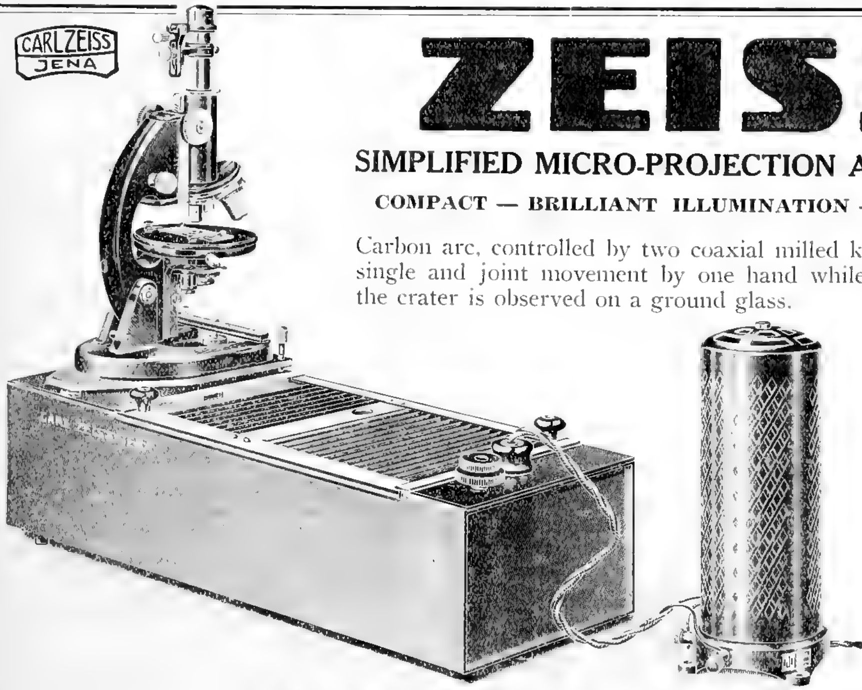
August 29	2:07	2:23
August 30	2:59	3:14
August 31	3:46	4:03
September 1	4:30	4:52
September 2	5:17	5:40
September 3	6:03	6:30
September 4	6:49	7:15
September 5	7:37	8:11
September 6	8:30	9:04
September 7	9:23	10:06

In each case the current changes approximately six hours later and runs from the Sound to the Bay.



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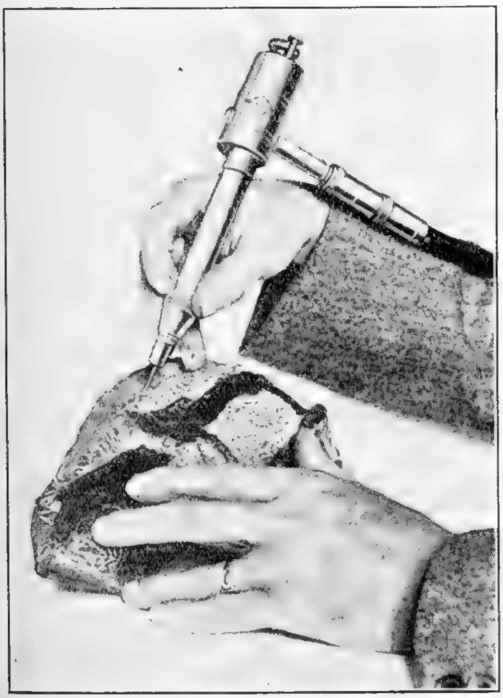

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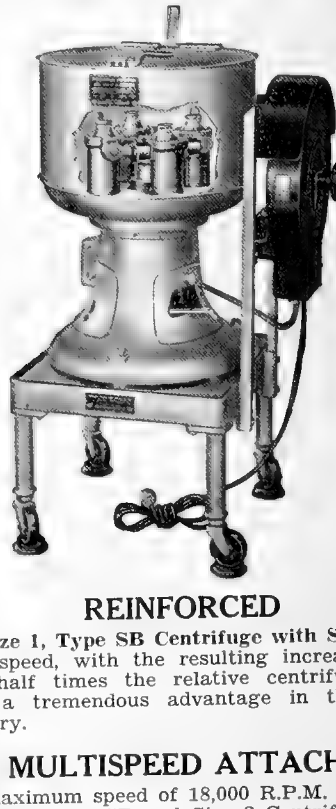

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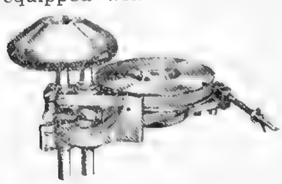

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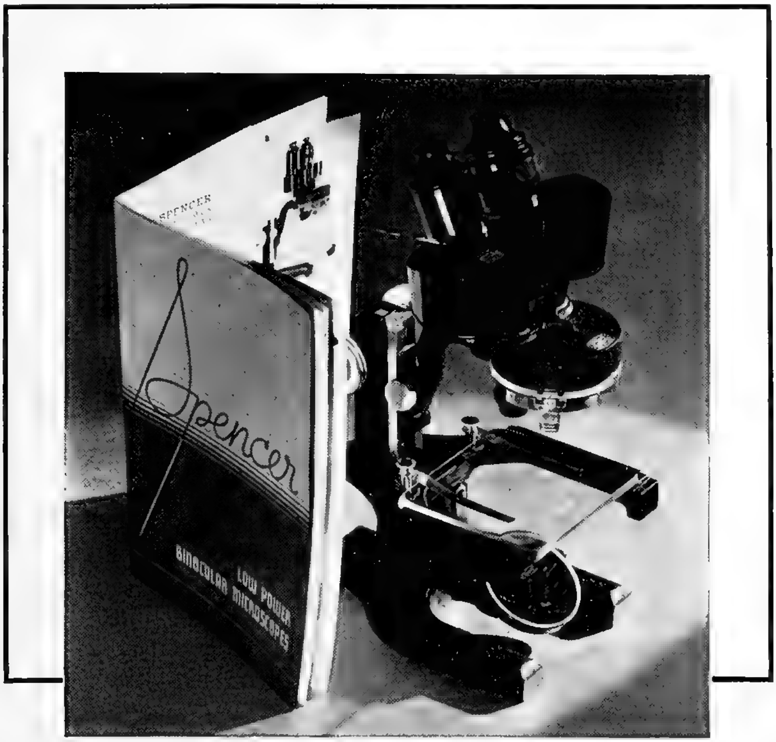

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THE COLLECTING NET

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RESEARCH FACILITIES OF THE U. S. BUREAU OF FISHERIES

ELMER HIGGINS
Chief of the Division of Scientific Inquiry, U. S. Bureau of Fisheries

In response to the growing interest in the conservation of natural resources and through the influence of the newly formed American Fish Culturists Society, now the American Fisheries Society, Congress created in 1871 a Commission of Fish and Fisheries with the duty of determining to what extent the fish supply of our coasts, rivers and lakes had declined and the causes thereof and of recommending remedial measures to the Congress and to the State Legislatures. The first commissioner, Spencer Fullerton Baird, then assistant secretary of the Smithsonian Institution, established the work of the new commission upon a firm foundation by undertaking a program of scientific studies of the fisheries, the commercial and game fish species on which they depend, and the organisms upon which fish feed or which prey upon them. [This work was prosecuted upon as extensive a basis as facilities permitted and in accordance with the (*Continued on page 252*)

M. B. L. Calendar

PERIOD OF INSTRUCTION FOR 1937

Physiology: June 16 - July 24
Professor Laurence Irving

Protozoology: June 19 - July 31
Professor Gary N. Calkins

Embryology: June 22 - July 28
Professor H. B. Goodrich

Botany: June 27 - September 3
Professor Wm. Randolph Taylor

Invertebrate Zoology: July 30 - September 8
Professor T. H. Bissonnette

RELATIONS OF SYMMETRY IN THE DEVELOPING EMBRYO[1]

PROFESSOR ROSS G. HARRISON
Chairman of the Department of Zoology, Yale University

Samuel Butler has answered the old riddle of the egg and the hen by reminding us that a hen is only an egg's way of making another egg. This remarkable anticipation of the Weismann theory at once states one of the most perplexing biological problems in its simplest form. The mysterious cycle of hens and eggs is resolved into a row of parallel lines, each representing the development of a single egg into a hen and all springing from a base line, the succession of germ cells.

There are two phases to the problem of reproduction. The one arises from the lucky circumstance that the cooperation of two parent cells is usually required to initiate development and is concerned with the mixing and reassortment of qualities from generation to generation. Its rules are simple and capable of precise formulation. It is the modern

[1] Preliminary report of a paper read at the Harvard Tercentenary Conference, to be revised before final publication.

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Photograph by Howard M. Wood, New Bedford, Mass.

AN AERIAL VIEW SHOWING THE LOCATION OF THE THREE BIOLOGICAL LABORATORIES IN WOODS HOLE

RELATIONS OF SYMMETRY IN THE DEVELOPING EMBRYO

science of genetics. The other phase, which is concerned with the development of the individual, has only begun to be touched by genetics. Embryology has gone its way independently, without a master hypothesis like the theory of the gene to guide it.

Embryonic development consists of a series of events which may be conveniently dated from the time of maturation and fertilization. The egg is quite as specific as the mature organism, in that it develops only into an adult of its own species. Environmental factors may produce modifications, they may even change the sex, but they do not change one species into another. There is abundant evidence that each species has definite chemical characteristics. Experiments in heteroplastic grafting and in species hybridization, the serological study of blood relationship and the chemical and crystallographic study of similar proteins from different species all point unequivocally to this conclusion. We must, therefore, assume some sort of chemical configuration characteristic of the protoplasm of each species of organism.

Because of the visible complexities which arise in the embryo it is often said that development is a change from the simple to the complex. This is illusory, for the egg has implicitly all the characters of the species. Egg and organism are but different phases of the same entity. While the changes which we observe involve chemical and physical transformations in the original egg substance, the latter must be assumed nevertheless to preserve throughout the essentials of its specific configuration.

Cells have a dual organization. They are composed of nucleus and cytoplasm. The exact relations between these two constituents are obscure, but there are certain relevant facts that may help toward an understanding.

1) Neither nucleus nor cytoplasm can function indefinitely without the other, as shown by numerous experiments on Protozoa.

2) When nucleus and cytoplasm of different origin are associated together, sooner or later the nucleus assumes control of the characters developed.

3) Nucleus and cytoplasm must not be of too diverse an origin if they are to cooperate. Even in mixtures between different species of the same genus, disturbances usually arise, less marked in complete hybrids than in merogonic hybrids, in which all of the nuclear material is of one species and all the cytoplasm of the other.

4) Practically all visible differentiations undergone by the developing embryo take place in the cytoplasm. It is with respect to this constituent that the various types of tissue cells differ.

5) Changes in the nucleus due to cytoplasmic influence have been only rarely observed and then only in somatic cells in contrast with germ cells, as in the so-called diminution phenomenon first described by Boveri in Ascaris.

Since the nucleus can act only with cytoplasm of its own or closely related species and since all differentiations are carried out in the cytoplasm, we cannot regard the latter as purely neutral or plastic material which can be immediately molded by the nucleus. We must assume some cytoplasmic configuration, based upon its chemical composition, which fits with the nuclear composition. This is borne out also by the following facts now generally recognized.

The nuclear material has a definite orderly arrangement and is precisely divided at each mitosis and evenly distributed to the daughter cells. There is no fundamental nuclear differentiation except at the maturation divisions. On the other hand the cytoplasm may be very unevenly divided both as to quantity and quality, since there are already visible regional differences in the egg before segmentation and even before maturation. It would be false, however, to conclude that these cytoplasmic differentiations are due merely to visible materials accumulated in the different regions of the egg, for in many cases distribution may be changed by centrifuging without interfering with normal development. Whatever the basis for these differences, the cleavage process produces an embryo made up of cells in which the nuclei are alike, but the cytoplasm different.

The methods most generally used in experimental embryology consist in the amputation or incomplete separation of parts of the embryo or in their rearrangement by compression, transplantation or centrifuging. They were devised for the study of what has now come to be known as the 'determination problem,' which concerns itself

THE COLLECTING NET has been entered as second-class matter July 11, 1935, at the Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879. It is devoted to the scientific work at marine biological laboratories. It is published weekly for ten weeks between June 1 and September 15 from Woods Hole and printed at The Darwin Press, New Bedford. Its editorial offices are situated on the third floor of the Woods Hole station of the United States Bureau of Fisheries. Between June 1 and October 1 communications should be addressed to Woods Hole, Massachusetts; at other times they should be directed to THE COLLECTING NET, Garrison, N. Y. Single copies cost 30c; a subscription (containing not less than 280 pages) costs $2.00.

with the temporal and spatial restriction of potencies of the several parts of the embryo as development proceeds. They do not touch upon the actual nature of the physical and chemical changes underlying differentiation.

From the large mass of work done by these methods one important generalization stands out. In practically all eggs a part has the power to give rise to more than it would if left in its normal surroundings, and in many cases a part may give rise to a whole. This applies to egg fragments, when the nucleus is left intact, or to whole blastomeres separated in cleavage stages or, in many cases, also, to circumscript areas in much later stages of development. The power of regulation changes rapidly with development, especially immediately after fertilization. Eggs of different species differ immensely in this respect and in some cases the regulatory power is reduced almost to nil.

Even when there are regional differences in the embryo, the prospective fate of cells may be changed by subjecting them to different surroundings either within the embryo itself or in the medium. In the sea urchin egg, which Hörstadius has submitted to a most exhaustive study, there are tiers of cells in planes perpendicular to the axis of the egg. Each plays a definite rôle in normal development and when separated each gives rise to a certain type of defective embryo. Recombined in abnormal ways, the resulting embryos may be either abnormal or normal, depending upon the balance between materials from the two hemispheres of the egg. The experiments all point to the existence of two gradients running in opposite directions from pole to pole, the intensity of the potencies of the cell tiers being a function of the distance from the poles. The original polarity of the material is either preserved or else modified according to definite rules.

Other eggs behave similarly. In the amphibia not only are early segmentation and gastrulation stages capable of regulation, but also later embryos, where particularly the ectodermal areas have been shown each to have diversified prospective potencies, only one of which is normally realized. This quality of 'wholeness' in the parts of the organism, particularly the embryo, has led to much speculation and even to a system of philosophy. It is the capital problem of embryology to find the physico-chemical basis for it.

Since each nucleus carries the whole genom of the individual, one might be inclined at first sight to attribute the quality of 'wholeness' solely to it. For reasons stated above this is inadmissible. We must seek also in the cytoplasm, which effects the differentiation, a basis for the characters of the organism. This must be assumed to be some kind of a 'repeat' configuration, in each unit of which the qualities of the whole, including its symmetry and polarity, are in some way implied. We have to explain, then, how such a system can shake out of itself the macroscopic design, composed of different organs and tissues, characteristic of the adult organism.

Confronted with something we do not understand, we naturally look for models which resemble the system in certain respects and thus lead to a better understanding of it. Crystal models have been employed in morphology for years, but their use has often met with scornful criticism. A rigid and angular crystal seems very different from the living organism. In recent years, however, the concept, crystalline, has been much extended and the sharp distinction between crystalloid and colloid, even that between solid and liquid, has broken down. X-ray analysis shows that many substances, formerly regarded as colloidal, have crystalline arrangement. Also, a paracrystalline state, in which the mobility of liquids is combined with a definite configuration is now recognized. In the crystalline state atoms or atom groups are arranged, as in a space lattice, each point of which has the same relation to surrounding points as any other point has to its surrounding points.

Nearly all animals, like crystals, have characteristic symmetry relations, of which the most common form is the bilateral symmetry found in representatives of many different phyla. This is a very low degree of symmetry, such as is found in hemihedral crystals of the monoclinic system, but in many coelenterates and particularly in the radiolarians, the symmetry is of a higher degree. In many animals, however, the superficial bilateral form merely masks a more fundamental asymmetry, which comes to fullest expression in the gastropods, but is quite definite throughout the vertebrates and possibly obtains to some extent in all organisms. The protein molecule which contains many asymmetric carbon atoms is also asymmetric.

In asymmetric species, which are usually so in one sense, individuals occasionally arise which are asymmetric in the opposite sense, that is, are the mirror image of the normal. Left handedness constitutes a partial inversion of this kind, and more rarely in man and other vertebrates complete situs inversus of the viscera may occur. In each species of snail the shell of all individuals is usually coiled in one direction but here again individuals may arise which are oppositely coiled. Crystals also occur as rights and lefts, as do many chemical compounds, particularly those with asymmetric carbon atoms. When such compounds are formed, the right and left enantiomorphs always occur in equal quantities except when either directly or indirectly the product of living organisms.

Genetic experiments of Boycott, Diver, Garstang and Turner, made with the pond snail Limnaea, in which inversely coiled individuals were crossed with the normal, show that there is a cytoplasmic basis for the inverse symmetry, which is not overcome by the dominant normal form until after a generation. Years before, embryological observations of Crampton, Kofoid, and Conklin had shown that the direction of coiling of the snail could be traced back to the egg in maturation. The direction of the polar spindles, as well as that of the spiral cleavage, was found to be opposite in right and left handed forms. From this it may be concluded that there is a definite cytoplasmic basis for the asymmetry, which is not changed immediately by nuclear influence. In the following generation, however, presumably during the growth period of the egg, the nucleus does bring about the inversion of the cytoplasmic configuration. The gene concerned is probably asymmetric and catalyzes at different rates the formation of the two enantiomorphs in the cytoplasm, or possibly even one to the exclusion of the other.

In bilateral organisms there are many paired organs which are asymmetric in themselves but the mirror image of the corresponding organs on the opposite side. Reversal of the asymmetry of such structures can be readily induced experimentally in amphibian embryos of appropriate age.

Time is inadequate for me to muster the large array of facts bearing upon either of the two main topics of this discussion. I shall therefore leave the earlier stages of development, confident that they will receive adequate treatment at the hands of Professor Spemann, and consider a single organ, the internal ear of the salamander embryo, which has engaged my attention for several years and which both illustrates the principle of localization and shows significant relations of symmetry.

As well known, the whole ectodermal pattern of the embryo is either directly or indirectly under the control of the organizer. The neural plate develops only when in contact with it, or with other organizing material that may be substituted for it. Lying outside of the neural plate, particularly in the head, there are a number of areas destined in normal development to become sense organs and other structures.

There is another system of organ rudiments, pronephros, limb, muscle plates, etc., which are formed in the mesoderm, i.e., directly out of organizer material; and still another in the endoderm. The cells in each of these systems are assumed to be at first potentially alike, the local restriction of the potencies gradually becoming more and more definite. There is a difference in the way this takes place in the different layers. In the mesoderm and probably also in the endoderm it is an autogenous process, whereas in the ectoderm it is dependent upon the underlying layer.

In studying the ear we are interested more particularly in the ectodermal localizations. What is it, for instance, that makes the ear form at a particular spot; the nose, the lens, the balancer, and other organs at other points definitely related topographically to the embryonic axis and to each other? This is, of course, but part of the general problem of localization, one that lends itself readily to experimental analysis. In the case of the ear there are three possibilities that suggest themselves immediately. Its differentiation might be due to its relation to the surrounding parts of its own germ layer. It might be due to the underlying primary organizer, or again to a kind of secondary organizer in the central nervous system. Transplantation experiments with embryos in the stage when the medullary plate is scarcely outlined (Stages 13-14) show that all three of these factors may contribute towards the end result. In other words, the presumptive ear ectoderm is already predisposed to form an ear although the whole ectoderm is still totipotent. A certain spot on the underlying mesoderm can initiate the formation of an ear from strange ectoderm in the absence of the medullary cord. On the other hand, a certain region in the medullary cord, centered at the level where Mauthner's cell will differentiate, also has the power of induction of an ear when brought into contact with ectoderm from any region. Even a half of the medullary cord reconstituted, after removal, by the remaining half, has this power. However, none of the ears produced in this way by one agency alone, or by two acting together, are perfect. According as one or more different influences have been acting, ear vesicles are formed with different degrees of perfection. The most perfect cases are obtained after operations in which the only thing done was to remove the underlying mesoderm, leaving the ectoderm and the medullary cord to cooperate along with the small amount of mesoderm which may move into the gap made by the removal of the main portion of this tissue. The least perfect seem to be those in which the hind-brain alone acts upon strange ectoderm in the absence of normal mesoderm.

A brief description of some of the experiments will indicate how these conclusions have been arrived at. The influence of the medullary tube is eliminated by cutting out either unilaterally or bilaterally the presumptive hind-brain from the early medullary plate and replacing it by ectoderm taken from another part of the body. The missing half of the hind-brain after unilateral operation is, however, reconstituted to a remarkable extent and may act as inductor directly upon the overlying ectoderm to form a small ear, though usually the ear is formed at some distance from the cord, presumably under the influence of the mesoderm. The

bilateral operation gives a more crucial experiment. Then the underlying mesoderm is the only possible agent that could stimulate the formation of the ear vesicles which develop. In the experiment just referred to, not only the medullary plate but also the presumptive ear ectoderm was removed. However, if the latter is left in place and a narrower piece of abdominal ectoderm is grafted over the wound caused by the removal of the medullary plate, then frequently two ear vesicles develop on each side, one induced in the graft through the action of the substratum, the other from the ear ectoderm of the host, either by self-differentiation or possibly also influenced by the substratum. If the wound in a unilateral operation is covered by ear ectoderm instead of ectoderm from the belly, then the ear vesicles that develop are somewhat more perfect, showing again the predisposition of this region to form an ear.

Before proceeding, it is appropriate to describe what takes place as the ear area becomes more and more definitely circumscribed. Three different chains of events, which occur more or less independently, have been observed. First, there is a gradual marking out of the disk from the general ectoderm, as described in Amblystoma by Kaan and Yntema. The second concerns the axial or symmetry relations, which have been found to change concomitantly with the segregation process, but to some extent independently of it. Finally there takes place a differentiation of areas within the ear, which accompanies to some extent some of the changes in symmetry relations. The physico-chemical factors which underlie the transformation of the disk of ectoderm cells into the complicated labyrinth are entirely unknown. The first changes, which consist in thickening followed by the pitting in and folding of the original plate, are probably accompanied by the taking up of water and a change in shape of the cells, as in the medullary plate according to Glaser. The gross change is, roughly speaking, the transformation of a circular plate into a sphere. From the walls of the latter, the semicircular canals and other chambers are formed by unequal growth and constriction.

Transplantation experiments show that at first the ectoderm of the ear region and surroundings is isotropic about an axis perpendicular to its surface. Just as the neural folds are closing a change supervenes. The ear plate, which is still not visibly differentiated from the surrounding ectoderm, undergoes a monaxial polarization. These facts have been shown by the following simple experiments. A square plate of ectoderm is lifted and replaced in some particular orientation by a similar piece of ectoderm from another embryo, one of which has been stained intra vitam by Nile blue sulphate. With rotations of 0° or 180° there are four possibilities. The plate from the same side may be grafted upside down or right-side up, thus reversing both of the axes at the same time or neither of them. When it is taken from the opposite side, either the dorso-ventral or the antero-posterior axis is reversed, the remaining one not. The conclusions which have been reached are based upon over seven hundred experiments of this kind made at eleven different stages of development.

In the isotropic period, all orientations yield normal ears with few exceptions. In the period of monaxial polarization which lasts some hours after closure of the neural folds two of the orientations—grafts which are oriented normally and those from the opposite side with antero-posterior axis normal but dorso-ventral inverted—yield normal ears, while the other two orientations yield ears which are disharmonic in that they are of the side opposite to that on which they are placed. This occurs irrespective of the side of origin of the graft. A little later conditions again change, indicating a transition from an indifferent dorso-ventral axis to one which is definitely polarized. When this axis is normally placed, a graft from the right side always develops into a right, and one from the left into a left, but when the graft is placed with dorso-ventral inversion, a marked disturbance arises in many cases. The vesicle swells excessively, sometimes with almost complete obliteration of partitions and sensory areas. Finally, a stage is reached about the time the vesicle is ready to be constricted off from the ectoderm, in which the transplanted ear develops essentially as placed.

In the isotropic period and in that with monaxial polarization, the ear rudiment is an equipotential system, by which is meant that any part of the rudiment can give rise to any part of the ear, as shown by the following experiments. A fractional part of the plate may give rise to a whole ear; two may be fused together to form a single one and a right ear may develop from a graft taken from the left side. This forces the conclusion that the vectorial properties of the organ, in fact its whole configuration, are represented in the ultimate structural units of the rudiment and not by a mosaic of coarser grain.

Grafts made during the first critical stage, that is, when the antero-posterior axis is becoming polarized, frequently result in enantiomorphic twins. These are always mirrored across a transverse plane and may consist of either two anterior halves or two posterior halves. Partial twinning, involving either the semi-circular canals, which develop from the ventral half of the ear plate, or the saccule, which develops from the dorsal half, also occurs. There are 10 possible classes of these twins, of which eight have been actually observed. In these experiments twinning never takes place across a horizontal plane, that is, along the dorso-

ventral axis. Such twins can be produced, however, by grafting a second hind-brain on the outer or lower side of the ear placode at a sufficiently early stage. The latter is then under the influence of two hind-brains, acting in opposite directions. The ears which develop under these circumstances are irregular and badly distorted, since it is difficult to gauge the proper amount of ectoderm to leave between the two hind-brains. A number of cases with double endolymphatic apparatus have, however, been obtained.

I have now reached ground where angels might well fear to tread. The facts just assembled and many others that might be added necessitate, in my opinion, the assumption that the processes of development, leading up to the final form of the organism are but the expression of the forces involved in the molecular configuration of the egg protoplasm. Yet it seems wild to speculate about this when students of the living cell cannot even agree as to what the physical state of protoplasm is—whether it is a fluid or is more of the nature of a lyophilic colloidal gel. Many microdissectionists and most observers of the streaming of the protoplasm of the plant cell describe the living substance as an emulsion with a liquid dispersion phase. On the other hand it has been observed to exhibit elastic properties (Seifriz) and recent observations by Harvey on the Amoeba subjected to high centrifugal force indicate that visible particles are moved through the protoplasm in a jerky way, as if they were bumping against solid obstacles. Again, Moore's experiments in forcing the myxomycete plasmodium through filters of various degrees of fineness show that even this organism, which is about the most amorphous one imaginable, is dependent for its existence upon the structural integrity of its protoplasm. It has been shown that many unsegmented eggs, when subjected to fairly strong centrifugal force, still develop normally even though visible particles may be quite definitely stratified in an abnormal way. Particularly striking in this connection are the experiments of Conklin in centrifuging the egg of Crepidula. The maturation spindle may be stretched from its anchorage near the pole, so that very large polar bodies are given off. On release from the force the protoplasm returns to its original form and development proceeds normally. It seems to me quite impossible to explain such phenomena as occurring in a purely fluid system.

Biochemists are recognizing more and more the importance of molecular configuration and orientation in the organization of protoplasm (Hardy, Peters, Jordan Lloyd, Needham and others). The work on the chemical side may now be woven in with the results of x-ray crystal analysis to give a picture, however hazy it may be, of the finer structure of living matter.

Living protoplasm is a complex system, consisting of water, electrolytes, protein, and other organic compounds—enzymes, carbohydrates and lipoids. There are many who think that protein, as such, does not exist in protoplasm and that in studying proteins we are only dealing with dead material. But organic chemistry leans heavily on the assumption that the structure of substances is revealed by the character of their decomposition products. It seems that we are justified in applying this same principle to the study of living matter. Proteins are certainly the most specific constituents of protoplasm and the only ones which can account for the innumerable varieties or species in which the living substance occurs. A consideration of the nature of the protein molecule should, therefore, prove instructive.

Proteins, though of wide diversity, have one fundamental feature in common. They are composed of chains of amino acids joined in peptide linkage, each segment or link consisting of a nitrogen and two carbon atoms. These constitute the stem or backbone of the repeat design. One of the carbons has ketone oxygen linked with it, the remainder of the carboxyl group of the amino acid. The other carbon has attached to it as a sort of appendage or side chain, the amino acid residue. Many of these segments are added together end to end in the protein molecule, into the composition of which a number of different amino acids usually enter, so that the side chains are of a number of different kinds. The molecule may be drawn out almost indefinitely, according to the number of amino acid molecules which are linked together. While it is potentially a fiber, Svedberg's determination of dimensions and molecular weight of a great variety of protein molecules by means of the ultra-centrifuge, show them to be of compact form, with molecular weights in multiples or submultiples of ca. 34,500. Wrinch has shown how the chain form may be folded into much more compact cyclized configurations. The so-called denatured proteins, such as fibroin from silk, keratin, collagen, frequently assume fibrous form in the organism. X-ray diffraction pictures show a definite spacing of the molecular groups, indicating a crystalline structure that fits well with the chemical structure described above. Astbury has shown that there is a different spacing in the keratin of stretched and in that of unstretched wool. It is also known that in substances like rubber and gelatine the molecules may be oriented by stretching. The stretched substance gives a very definite x-ray picture like that from a single crystal, while the unstretched form gives only a set of concentric rings typical of the crystal powder picture.

There are other characteristics of the protein molecule important in this discussion. At one end of the amino acid chain there is an uncombined carboxyl or acid group, while at the other there is

an amino group, which is alkaline. As electrolytes they are therefore amphoteric. They dissociate as acids or bases according to the hydrogen ion concentration of the medium and at the isoelectric point they form double or Zwitter-ions. Moreover, many of the amino acids have an unequal number of basic and acid groups, giving basic or acid side chains in the proteins into which they enter. Thus, according to Jordan Lloyd, the protein molecule has a backbone which is chemically stable and limbs which have possibilities of chemical activity. In solutions and presumably in living protoplasm the backbone is not highly solvated, while the head, tail and side chains are—an arrangement which gives physical stability combined with diversified chemical activity. Indeed, were Pangloss here, he would surely prove that 'in this best of all possible worlds' the protein molecule was designed to form living protoplasm.

In the cell such molecules would tend to become oriented in a definite way, particularly at interfaces. Under certain conditions they would form fibers with parallel arrangement, while under other conditions they would assume the more compact or folded form, which would likewise tend to assume a definite para-crystalline configuration, involving a large amount of water of crystallization. Such a structure would be very tenuous and might even go over into the fluid state, only to resume its structural form when intracellular conditions again change.

Considering the relation of the protein molecule to the developing egg and going back to the early growth period of the oöcyte, let us see how its properties may be related to the qualities of polarity and bilaterality. Such molecules as we have described may be supposed to assume a polar arrangement with one end anchored at the surface of the cell at one pole and to run in parallel series to the other pole, where the opposite ends are attached, or they might have a less regular arrangement in the intermediate zone. If the two ends are 180° apart, and no further orientation occurs, the figure is symmetrical about an axis and has an infinite number of planes of symmetry. Let one end shift even a short distance from the geometric pole, then the symmetry is reduced macroscopically to the bilateral class, but a single plane of symmetry remaining. Practically all eggs are bipolar, and the poles, in many cases at least, have a definite relation to the attachment of the egg in the ovary. This fact of being attached must not, however, be assumed to create the polarity of the egg but simply to orient its constituent particles.

Protein molecules are asymmetric. Not only are the two ends different, but also the two sides as well as the two remaining opposite surfaces. If such molecules are oriented with reference both to ends and to surfaces, then the dorsal and ventral directions are represented in the finer structure as well as in the coarser visible arrangement. The asymmetry in the third dimension might be masked at first, by the outer configuration of the cell, only to manifest itself later in development. This is borne out by the fact, discovered by Spemann, that in the amphibian embryo asymmetry may be inverted by gross mechanical factors such as rotation of the archenteric roof or longitudinal division of the early embryo, in which latter case it is the right hand twin that usually shows inversion of the viscera. In eggs with spiral cleavage, however, the asymmetric configuration is visible from the time of maturation on.

During the growth period of the egg, a large amount of material is transferred to it and, owing to the polar arrangement of the primary protoplasmic molecules, as well as to its mode of attachment in the ovary, the substances laid down will form gradients, extending from one pole to the other. We thus have superposed on the primary gradient, which is due to the presence of the polar molecules, a second material gradient which may be of a double nature, one material being more concentrated at one pole and the remaining one at the other. During maturation and fertilization there is a solation of the egg contents with resultant streaming and rearrangement of materials before cleavage sets in. This must involve a radical disturbance in the molecular set-up, but in the new state of equilibrium which supervenes there must be an arrangement which again conforms to the molecular configuration. Spek has shown that during this process in some eggs basic substances accumulate at the animal pole and acid substances at the vegetative pole, possibly due to electrophoresis. Something of the old configuration must remain however, for the polarity of the egg is not changed.

Even in the undivided cell further localized activities may be assumed as due to the interaction between the primary structural material and the material constituting the secondary gradients. Such reactions would, however, be more efficient after cells had divided and cell walls intervened between the different regions of the cytoplasm. In order to account for these localized differentiations it is suggested that the chemical composition prevailing in a particular region activates certain side chains in the molecules of that region more than others. Thus new substances are formed locally making the cells in the different regions behave differently although their fundamental protoplasmic composition still remain the same. Differentiations of this kind, through the activation of one type of side chain or another, produce new situations which start up new side chain activities regionally. These activities are all centered and in themselves show a gradient inversely proportional to some power of the distance from the cen-

ter. As this type of change goes on through the accumulation of the substances due to side chain activity, the cells become saturated, so that differentiation in other directions is inhibited, thus leading to the condition which is now usually called 'determined.' Yet the characters of the specific molecules are left intact, since living protoplasm has the way of working through agents which it forms without changing itself essentially.

After the establishment of the original polarity, the first differentiation of the above kind which takes place in the amphibian egg is in the material of the gray crescent, probably in that which is first invaginated and which will become the roof of the pharynx. The notochord is differentiated almost at the same time, likewise extending across the midline. The area for mesoderm is further off to the side and later smaller areas for the muscle plates, the limbs, and the pronephros are formed within it. By the time the material of the border zone is rolled in and gastrulation completed, these areas, at least the main ones, have reached the stage of differentiation when they are no longer interchangeable. The whole animal hemisphere of the egg at first is undifferentiated within itself, though differentiated from the opposite hemisphere through the primary polarity of the egg. Its differentiation lags and in fact cannot be detected until after the border zone material, which constitutes the organizer, has been turned in. Under the influence of the central part of the latter, consisting of the pharyngeal roof, notochord and the more axial part of the mesoderm, a marked change takes place in the overlying area and the medullary plate is marked off. The further differentiations, may be assumed to take place in the ectoderm by this same process of activation of different side chains in the protein molecules, but here the agent which activates does not lie in the layer itself so much as in the underlying layer, the organizer. Many reactions must be due to substances arising from the genes in the nucleus. Others may be set up or intensified by conditions in the external medium, as for instance when the endodermal region of the sea urchin embryo is extended through the action of lithium salts (endodermization) or when the opposite effect (ectodermization) is produced by sodium thiocyanide.

In this concept of development we have, to a certain extent, a combination of the old theories of preformation and epigenesis. It may be described as epigenetic in that the various characters of the future organism do not appear at first as such, but are realized through reaction between the several constituents of the egg and also between them and the environment. It is preformational in that there is something in the configuration which determines its physical arrangement and the kind of chemical action which will produce the end results. In other words the qualities of the organism are traceable to the specific properties of the molecule. To be included in this category are all of the things that the molecule may do when brought into relation with the substances that it may encounter within the bounds of the developing organism.

Considerable stress has been laid on the study of orientation in the investigations on the ear. Its importance rests upon the fact that in rotation experiments only a very simple vectorial change is imposed, from which simple conclusions may be drawn. You will recall that the ear rudiment first passes through a stage which may be described as isotropic about an axis perpendicular to the surface ectoderm and that at a certain stage there is evidence of definite antero-posterior polarization of this layer. The whole ectodermal region is, in fact, so plastic during the stages of gastrulation and early neurulation that neither local nor vectorial differences in its qualities can be readily detected. Just as the neural folds are closing, something occurs which orients some constituent of the protoplasm in an antero-posterior direction and this becomes very definitely fixed, since it is difficult to change it by rotation. That this orientation is fundamental is shown by the fact that at the same time the direction of the ciliary beat of the ectodermal cells becomes fixed, as well as the direction of the outgrowth of the lateral line rudiment.

The orientation in question may be due to several factors combined. In the first place it is quite noticeable that the ectoderm of that region is markedly stretched during this period, along with the longitudinal stretching of the central nervous system. This alone might have some orienting effect as has been shown by the remarkable molecular changes which accompany the stretching of wool, rubber, etc. Since the mechanical stretching might effect a parallel arrangement without orienting all of the individual elements in the same sense, it is necessary to assume a further orienting factor to account for the latter. Contact with the central nervous system at a certain point may play this rôle, for it is possible to reverse the orientation of the ear simply by turning the medullary plate, though not so regularly as when the ear rudiment itself is rotated. When twinned ears develop, as is most common in the critical stages, some interaction between the elements of the two halves must take place, such as occurs when twin crystals are formed.

The technical difficulties of obtaining x-ray diffraction pictures of living material are great, but they have been overcome, at least in some measure, by Boehm and his associates, who have succeeded in obtaining pictures of living muscle, tendon and nerve, as well as pictures of the dried tissues by exposures of only a few minutes. Muscle shows a definite molecular spacing indicating ori-

entation in a longitudinal direction, which largely disappears on contraction. Its principal constituent, myosin, when drawn out into a thread, gives a diffraction picture characteristic of crystalline fibers.

In the hope that it might be possible to get some evidence of oriented structures either in the ear rudiment or in the medullary plate, which also becomes rigidly polarized, x-ray diffraction photographs from dried specimens of these tissues have been made but so far without success. No more evidence of structure has been revealed than might be found in unoriented gelatine gel. However, the technique which was employed in preparing the tissues would probably have damaged any delicate structure that might have been present and further experiments with better technique, especially with fresh tissues, now that short exposures are possible, may give more definite results.

In summing up the views expressed this morning, I am fully conscious of their crudity and onesidedness in contrast with the extremely delicate and complex transformations they attempt to describe. It may all seem to you but an echo of Wagner, when he says to Mephistopheles as the Homunculus is about to be created:

> "Was man an der Natur Geheimnisvolles pries,
> Das wagen wir verständig zu probieren,
> Und was sie sonst organisieren liess,
> Das lassen wir kristallisieren."

The data of experimental embryology have, however, remained too long isolated and the problems peculiar to it have not attracted sufficiently the attention of the general physiologist. Our widening knowledge of the physico-chemical properties of protoplasm and the vista opening up through advances in organic chemistry and x-ray analysis amply justify the attempt to bring these fields into closer union. In endeavoring to reach a physico-chemical description of life one is baffled rather by the bewildering array of possibilities than by such dearth of material as would warrant the evocation of peculiarly vitalistic forces. At least I am unwilling to accept the defeatism of the vitalist, so long as means of investigation by experiment are available.

The principal thesis maintained in the foregoing is that the specific form of the organism is mainly an expression of the molecular configuration of the protein constituents of its protoplasm. In the egg cell these tend, through the action of molecular forces, to arrange themselves in a definite way similar to the arrangement of atoms or atom groups in liquid crystals. The large amount of water associated with these crystalline substances — water which must enter into the meshes of the crystalline network, that is, into the actual lattice cells—gives them a very great lability. But the intermolecular forces are sufficiently constant to hold the molecules in their characteristic configuration and even to restore such configuration if mechanically disturbed. The changes which we call differentiation, which is the transformation of a universal repeat pattern to a macroscopic pattern of specialized organs and tissues, takes place through the local activation of the particular side chains of the protein molecules. One local change leads to another until the end stage of what is called segregation seems complete. But it is not a true segregation. The original protein molecules must be assumed to remain unchanged, at least to the extent that they still preserve the protoplasmic characteristics of the species.

Such a theory combines various concepts that have come into embryology in recent years: that of the organization center and the hierarchy of organizers as conceived by Spemann, the idea of morphogenetic fields, and the axial gradient theory of Child. Others before me have, of course, used the crystal analogy and Przibram has presented the whole subject in a very interesting way. The crystal has been usually taken as a model in these discussions, but Needham goes much further, when, near the end of his stimulating book on "Order and Life" he says, "Liquid crystals, it is to be noted, are not important for biology and embryology, because they manifest certain properties which can be regarded as analagous to those which living systems manifest (models), but because living systems actually *are* liquid crystals, or, it would be more correct to say, the paracrystalline state undoubtedly exists in living cells." This may be an advanced position to take at the present time, but then progress is made only by taking advanced positions.

ON THE MODE OF OPERATION OF THE 'ORGANISATOR'[1]

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I intend to report to you on some investigations of the past fifteen years which had their origin in two simple experiments. These were carried out on young embryos of different species of Amphibia and consisted in the removal of specific re-

[1] One of the papers in the symposium on "Biological Sciences," of the Harvard Tercentenary Conference of Arts and Sciences; from "press" copy.

gions of the germ and the replacement of the part by material from another place.

If one replaces a piece which later would become brain, i.e., presumptive brain material, by a piece of presumptive epidermis, (it is most satisfactory when the two pieces are mutually interchanged), they develop corresponding to their new position; presumptive brain does not become brain according to its origin, but becomes epidermis in accordance with its position, and similarly, the presumptive epidermis becomes brain when placed in the region of the brain. This can be established with certainty by previously vitally staining one embryo, or, if one prefers, by making the interchange of parts between two embryos of different species which differ in color and pigment-content, as was first done by Harrison in other experiments. In the present case, for example, between the dark-pigmented embryos of *Triton alpestris* and the entirely or approximately pigmentless embryos of *Triton cristatus*.

It follows from this that the interchanged pieces still possess in that early stage of development, capacities or potentialities of both sorts, that is, both for the formation of brain and for that of epidermis; it follows further that in the positions of the brain and epidermis respectively there reside forces of some sort which direct the foreign material, impelling it in the direction of brain or epidermis as the case may be.

The second experiment gives more detailed information concerning the determining of the medullary plate, especially about the part of the embryo from which the determining influences proceed. In normal development the ectoderm which gives rise to the medullary plate is supported by mesoderm. Its transformation into the medullary plate could be dependent upon this. This hypothesis can be tested by placing such mesoderm under the ectoderm of a foreign region. It may be shown that in this case a supernumerary medullary plate arises. Mesoderm can, therefore, induce a medullary plate and it is reasonable to assume that the normal medullary plate also arises by an induction from the site of the underlying mesoderm. All later experiments have confirmed this.

From these fundamental facts several sets of questions are now derived the experimental answers to which have led us deeper into the nature of development.

First of all we should like to know in general of what sort the influence is by means of which medullary plate arises from indifferent ectoderm; whether some sort of dynamic effect passes from the mesoderm to the ectoderm, or whether a substance is given off by the mesoderm which arouses the medullary potencies in the ectoderm.

The numerous experiments undertaken to solve this problem agree in showing that the inductive effect is mediated by means of some substance; indeed it is clear that very different substances can produce this effect, even substances of comparatively simple chemical constitution.

The experiments were made in such a fashion that the piece whose capacity for induction was to be examined was placed through a slit into the segmentation cavity at the beginning of gastrulation so that in the course of gastrulation it came to lie under the ectoderm. Parts of the embryo were tested whose structure had been disturbed to various extents even to the point of destruction of life, then animal tissues of the most diverse origins from tape-worm to man, finally chemically pure materials of known constitution. In all three groups countless cases of inductive effect were observed.

Under the influence of a living inductor there arose, however, not merely disorganized medullary substance, but embryos which were entire and normal in all essential respects with their own sensitivity and motility. This organizing effect could be exerted by a piece of mesoderm which had been taken from a completed gastrula and placed into the blastocoele. Or the mesoderm could be involuted into the host by a piece of the dorsal hip of the blastopore transplanted into its surface. This mesoderm which in one way or another had come to be in the interior, then formed the axial mesodermal organs, that is the chorda and somites, partly out of its own material, and partly by drawing to itself the tissue of the host. These parts then induced in the overlying ectoderm of the host a medullary plate which subsequently developed into brain and spinal cord, evaginated optic vesicles and its own lenses and auditory vesicles, formed from the tissue of the host. Thus an entire, highly developed embryo can be organized by a little piece of one young germ placed in another. This I summarized under the preliminary concept of the "organizer."

In this organizing action there is revealed a capacity of the organism which has long been known from other experiments, the capacity for regulation and construction of a completed whole. First of all as to the organizer: a fragment of the mesoderm forms complete, bilaterally symmetrical axial organs and, indeed, in two ways. It regulates itself into a bilateral condition within itself, as does the isolated half of the sea-urchin egg, according to Driesch's fundamental discovery and it incorporates from its immediate surroundings that which it lacks, as Roux, years ago, described in his post-generation. With young organizers inner self-regulation preponderates; with old ones, on the other hand, the appropriation of foreign material is predominant. Only from these bilaterally symmetrical axial-organs is a bilaterally symmetrical medullary plate induced in the

overlying ectoderm. Whether the tendency to form a whole is present also in the ectoderm, that is, in the reaction-system, is a question which will occupy our attention again at the close.

But, at present, there is still another point. Even in the first cases observed by Hilde Mangold the secondary embryonic arrangement had definite positional relationships to the primary. Their axial organs were arranged exactly as those of the host, and the characteristic cross-sections of the two, through the auditory vesicles, for example, lay in the same level. From this the question arose as to what determined the position and segmentation of the induced embryo. Numerous experiments made to answer this question have shown that this relationship is not an unconditionally fixed one, but that evidently influences which help determine the position and segmentation of the secondary embryo proceed from the primary embryo. This finding has in turn led to very interesting discoveries for the understanding of which, however, still another set of facts must be presented.

As we have seen above, uncommonly diverse agents may induce a medullary plate. Hence it is now no longer difficult to understand, that the medullary plate itself likewise belongs to these possible inducing agents, indeed, that even the brain can induce; further, that normal inductors, namely the mesodermal axial organs, also retain their capacity for induction far beyond the time during which they can normally play a rôle. But how does it happen then that medullary plates are not continually induced in the normal epidermis, which covers such potential inductors as spinal cord or somites? The simple reason for this is, as, above all, O. Mangold has shown that the preparation conditions necessary for the formation of medullary plate are present in the ectoderm only during a short period of the development. One could expect, therefore, that a piece of ectoderm capable of reacting would respond in the same location by the formation of medullary plate. That is, in fact, the case.

J. Holtfreter has grafted small pieces of ectoderm from the early gastrula into the sides of older embryos from the stage of the neurula up to that of the extended embryo and thereby obtained the induction of medullary plate. But not only that; most diverse other organs such as the olfactory pit, balancer, gills, musculature, notochord, and pronephric canals were called forth in this material of many potencies. However, they were not distributed at random over the entire length of the body, but arranged according to region. This shows that the embryo itself, even in later stages of development, is subdivided into active fields which exercise no noticeable effect upon their normal surroundings, yet become immediately recognizable as soon as a piece of reactive tissue is brought into their sphere of influence.

One must regard as an instance of this field-dynamics the case mentioned above, in which the auditory vesicles of the induced embryo lie at the same level as those of the primary embryo. Their origin is therefore the effect of at least two fields; one of which proceeds from the inductor without which epidermis would have developed in this region and a second which proceeds from the primary embryo and determines which general level of the medullary tube will arise.

The effect of this latter field or system of fields which is always present in the host appears clearly only when the orientation of the secondary embryo is the same as that of the primary. This in itself is not, however, a field-effect, but depends simply on the fact that the implanted organizer is carried along and extended by the mass movements of the host during the time of involution. This can be prevented and then secondary embryonic axes develop which are transverse to, or even the reverse of, the primary ones. In this case the field-effect of the organizer predominates; its structure determines alone or nearly alone the arrangement and structural composition of the secondary embryo.

Very recently Holtfreter has described a case of organ-induction which is not completely explained by this regional field-effect. A beautiful lens with incipient fiber formation has been induced in the region of the heart of a Triton larva by means of a boiled heart of a larva of Salamandra; that is, by means of an inductor, which cannot be specific for lens-formation, in a region which surely lies nearer to other fields than the lens-field. Here no explanation has been found to date other than this: the epidermis in a definite stage of development is to a certain extent loaded to the highest degree with the ability to produce a lens and that the inductor came into effective activity in this moment of highest readiness for reactivity for lens-formation. In a somewhat earlier stage the same inductor would have brought forth a medullary plate in the same place. —Many a beautiful discovery is still to be made here.

In closing may still another important question be touched briefly. It has already been suggested above in connection with the powers of regulation of the inductors and touches upon the question as to whether the reaction-system works toward totality; or more exactly expressed, whether the totality-stimulus which the inducing system emits, has a structure by means of which the structure of the induced formation is brought forth point by point, or whether the inductor acts as a homogeneous whole, to which the addressed system responds as a whole.

The fact just mentioned really already gives an answer. The stimulus which proceeds from a

piece of boiled salamander heart is certainly without structure and yet it can call forth the formation of a well-differentiated lens with incipient nuclear fibers. Other experiments point in the same direction.

As we have seen above, one can produce organs of heterogeneous composition by means of the interchange of tissue in the early stages of development, for example, gills which are covered by a kind of epidermis foreign to the species. This epidermis would have formed brain in the site of its origin; the new position has impressed upon it the nature of epidermis, but has not however changed its species-character. If one now in this fashion produces a structure which consists wholly or for the most part of epidermis, such as a balancer, or a lens, then one can test whether a definite, especially simple totality-feature, namely size, is determined by the inducing agent or by the responding-system.

To this end E. Rotmann replaced presumptive balancer-epidermis of *Triton taeniatus* with the inverted ectoderm of *Triton cristatus*. The chimaerical balancers showed exclusively the characteristics of the same species from which the ectoderm originated and not those of the species which had determined its becoming balancer-epidermis; indeed this was so not only in respect to size, but also in respect to the characteristic position of the angle in relation to the head. The balancers formed from *cristatus*-epidermis are directed anteriorly, those originating from the *taeniatus*-epidermis posteriorly.

The lens was tested in the same fashion as the balancer. Presumptive lens-ectoderm from *Triton taeniatus* was replaced at the beginning of gastrulation by inverted ectoderm from *Triton cristatus*. The lens likewise followed in size and tempo of development that species from which the ectoderm originated and not that which determined its becoming a lens. The lens-potency was not evoked by the optic cup according to the extent to which its invaginated retinal layer touched the epidermis; rather, to a certain extent, the lens is established as a whole by the epidermis.

In order to evaluate completely the significance of this fact one must bear in mind that the epidermis really does not lack the ability to accommodate the size of the lens which it yields to that of the optic cup. For if one reduces the size of the optic cup, the optic cup subsequently calls forth a lens which is correspondingly reduced. Rather the epidermis clearly does not receive the correct stimulus in the chimaera. The entire eye seems within limits to give out the command "entire lens" and this lens is then delivered by the *cristatus*-epidermis just too large for the *taeniatus*-eye, and *vice versa*.

Still more striking results are to be expected if it should be possible to combine embryos which stand systematically still further apart. With the combination of different species of Tritons, it was, after all, always a question of similar organs which differed only in isolated character. On the other hand, with animal forms which are systematically further apart, the larvae possess manifoldly different organs in the same position. Thus the larva of a frog has, as is well known, suckers in the place of balancers and in the place of teeth, horny jaws and in their neighborhood horny plates. What will now take place if an exchange is made? But first is an exchange and reciprocal action possible here?

Fortunately this latter is really the case. However remarkable it may sound, compatibility and reciprocal susceptibility to influence are both present. Thus the result is what is to be expected under these circumstances. If one removes a piece of presumptive epidermis of the oral region of the embryo of a Triton in the early gastrula-stage and substitutes for it ectoderm from a toad-embryo of like age, the organs of the toad, head, suckers and horny jaws develop in the Triton-larva in the exact region appropriate for them; and if the piece is too narrow to cover also the region of the balancers which are located further to the side, these can also develop in their proper place as well. With the reciprocal experiment, Triton-ectoderm planted on toad-embryo, balancers arise instead of suckers. This has now been completely established by the experiments of O. Schotté, E. Rotmann, J. Holtfreter and O. Mangold.

That is indeed a result of great importance. How is it possible that potencies of the toad-ectoderm respond to the induction-stimulus of the Triton head, that is, potencies for organs which Triton does not possess at all and stimuli which otherwise release entirely different responses? The releasing stimulus must in one respect be of quite specific nature because it brings forth that which corresponds to the region; in another respect however, it must be of quite general nature, because the induced structure arises in the manner which is peculiar to the piece originally foreign to the place. Figuratively speaking, thus, when the command, only a quite general "furnish the mouth," sounds, this is accomplished by the ectoderm in a manner which has been provided for in the inheritance of its species. However, as to what that actually means, physiologically speaking, it seems to me that we are, to date, lacking any well-founded conception.

Thus systematically progressing analysis has opened for us many a glance into the nature of development, but has posed still more enticing questions which can find an answer. One could not be a true scholar and not find this condition pleasing.

THE FUNDAMENTAL NATURE OF THE RESPIRATORY RHYTHM[1]

Sir Joseph Barcroft, *Professor of Physiology* and D. H. Barron, *the University of Cambridge*

The essential nature of the respiratory rhythm presents a problem which cannot but be of outstanding interest to biologists. The words inspiration and expiration have come to connote the highest life and the ultimate dissolution of man.

The explanations put forward group themselves around three principal conceptions.

(1) That each phase of respiration initiates a message to the brain, checking that particular phase and initiating its opposite. According to this view, which is associated particularly with the names of Hering and Breuer (1868) and of Head (1889) (a) respiration once arrested would never restart, and (b) in the absence of sensory impulses from the respiratory tract to the brain it would not take place.

(2) That there is in the central nervous system a continual urge to inspire, but that the very act of inspiration sets up sensory impulses which check the effort. The lung then reverts passively to its unexpanded condition. This view is associated particularly with the names of Gad (1880, 1881) and Lewandowsky (1896). It differs from the former in two essential respects

(a) the central nervous system is the essential seat of respiration and is not merely a telephone exchange, and

(b) expiration is a purely passive movement.

(3) That respiration is due to rhythmic activity of the central nervous system. The modern apologist for this view was Graham Brown, and it was strengthened by the observation of Adrian and Buytendijk (1931) that there existed in the central nervous system of the goldfish an inherent rhythm which had the same frequency as that of the gill movements.

The observations which I am about to describe support the third view. They were of a quite unexpected character and materialized from an effort in collaboration with Dr. Barron to investigate the nature of the earliest movements of which the sheep embryo is capable.

I need only make a passing reference to the controversy which has centered around the initiation of mammalian movement. Briefly, two views have clashed: the first, based on the unassailable work of Coghill (1929) on Amblystoma, holds that ordinary movements have individualized out of a generalized mass movement: the second, put forward by Windle (1934, 1935) is that movements have started in a localized way and become integrated into more generalized manifestations of activity. Our work on the large and slow growing embryo of the sheep indicates an element of unreality in this controversy. It has been assumed that the two conceptions set forth above were alternatives: actually they seem to us to represent successive stages in the life history of the sheep. The mass movement is built up from localized movements and when built up becomes resolvable into reflex or other movements of definite functional significance. It is with this mass movement that I wish to take up my parable.

The movement itself may be evoked on the 36th or 37th day in the sheep embryo whilst it is still in the embryonic sac. The point of a fine glass rod is thrust through the membrane—a procedure which does not involve the escape of any considerable quantity of fluid—and the snout of the embryo is tapped rather forcibly. The movement itself will be described shortly, but here let me say that whilst at first, on the 36th day, a single movement is elicited in response to the stimulus, a little later tapping the snout will evoke a series of two or three successive movements. By the 38th day the picture has developed in two important respects: firstly, the series has become a rhythm, embracing perhaps twenty movements and lasting it may be for half a minute: secondly, the necessity for tapping the nose has disappeared: the initiation and continuation of this rhythm is "automatic." In using the word "automatic" no more is meant than the movements appeared without the application of any stimulus which we knowingly applied. Even that is perhaps an over-statement because on one occasion we discovered accidentally a method of eliciting them. For purposes of photography we placed a sheet of glass on the surface of the sac and then exposed the embryo to the bright light. About half a minute after the glass had been placed on the sac the movements commenced. This we repeated several times, always with the same result except in so far as the latent period might be rather more or less than half a minute. Control experiments ruled out the light and the heat of the lamp: the effect seemed therefore to be due in some way which we did not locate to the glass, possibly directly or indirectly to the pressure it set up in the amniotic fluid.

From the 39th to the 49th days the properties of the movements changed in two respects.

(1) they became more restricted in extent,

(2) they became progressively easier to elicit.

Let us take the first point, the increasing localization of the movements.

On the 38th day the movements may be described as follows.

"The head appeared to be extended, the trunk straightened and the limbs and tail extended. These (movements) appeared rhythmically—a sharp contraction and a rather slow relaxation.

[1] One of the papers in the symposium on "Biological Sciences," of the Harvard Tercentenary Conference of Arts and Sciences.

On one occasion they were definitely initiated by extension of the hind foot of the left side with abduction of the toes. This rhythmic extension and relaxation of the leg occurred several seconds before the generalized extension took place."

The movements are spoken of as of the generalized extensor type merely on the basis of the appearance which they presented. Whether the extensor muscles only were involved, or whether all the muscles came into play and the extensor muscles overbore the flexors, producing extension as the net result, we cannot say: but in one experiment Dr. Windle pointed out to us that the head movement was of the following type, an extension which passed off rapidly, leaving the movement to finish as a more drawn-out flexion.

The first obvious change was for the extensor elements to disappear, and for the flexor ones either to remain or to be developed according to whether they did or did not form part of the original mass movement, thus.

"Sheep No. 110 41 days Length 40 mm.

"Immediately (on opening the uterus) rhythmic movements were seen . . . Each movement involved a flexion of the neck. Occasionally this was preceded by an extension of the neck. Sometimes there would be two or three such flexions without an extension to each flexion. The extension seemed sharper than the flexion."

By the 41st day then, the movements had assumed a flexor type. The neck movements first and then the leg movements ceased to be anything but merely passive, and by the 46th day the spontaneous rhythm wàs confined to the trunk. The body movements involved the drawing down of the diaphragm, which is fully formed about the 46th day. The rhythmic descent of the diaphragm is shown by the depression of the liver and the drawing-in of the chest wall which at this stage is quite soft. There is no appreciable negative pressure set up in the thorax. Except for the drawing-in of the chest wall, the movements after the 46th day closely resemble those of normal respiration.

Let us turn to the ease with which the movements may be elicited, if it is permissible to use that expression about a rhythm which has already been described as spontaneous. When we first saw the rhythm, evoked by a definite stimulus, it was in a 39 day foetus: it appeared sometime after the sac had been exposed and about half a minute after a glass plate had been placed thereon. Later, in a 41 day foetus, the rhythm was observed immediately on delivery of the sac, as soon as the embryo could be seen at all. The question arose whether actually in the uterus the embryo executed these rhythmic movements. We were successful on the 49th day in trans-illuminating the unopened uterus: the foetus exhibited rhythmic movements. It cannot be claimed even here that the foetus was entirely free from outside influence, for though the uterus was unopened some degree of manipulation was necessary in order to get the light into a convenient place which would enable us to "film" the shadow of the foetus. It must be remembered, however, that at this stage the foetus is floating quite freely in the sac (anchored only by the cord), and though we cannot claim not to have set up changes of pressure in the amniotic fluid, these probably were not greater than normally take place in life.

By the 49th day rhythmic movements of the nature described become almost continuous, and are to be observed in any foetus in good condition at that stage of its existence.

We commenced the above discussion by showing that on the 36th day an external stimulus evoked a spasmodic extensor movement and that at a slightly later date an extensor rhythm was observed. We then showed that the extensor rhythm might occur without the application of a definite stimulus on our part, and from that time our study took the form of observation of the rhythm with no intentional and the least possible degree of accidental stimulus. We now turn to another line of investigation followed by one of us (Barron) in which the stimulus, poking the embryo on the nose with a glass rod, was persisted with and the results observed.

Taking the matter up at the point at which the stimulus produces an extensor rhythm, it is found that about the 40th day only the first one or two "beats" of the rhythm show extension of the head; after that the rhythm is of the flexor type. Moreover if the nose is stimulated on one side of the middle line, the initial throw back of the head is not a symmetrical movement, though the subsequent rhythmic movements are. But this is not the beginning; as early as the 36th day (Sheep 65) faradic stimulation of the head in the region of the facial artery produced certain definite results.

"Stimulation of the face in the area of the Vth. nerve was followed by slight turning of the head towards the stimulus and extension of the contralateral foreleg at all the joints." (the foetus was removed from the membrane).

On the 37th day (Sheep 64) rotation of the head was obtained with a less powerful tactile stimülus.

"The glass needle was inserted into the membranes of the amniotic sac without loss of fluid and when the nose was stimulated in the area of the front anterial facial artery rotation of the head occurred towards the stimulus."

On the 38th day, the same embryo as had shown spontaneous rhythmic movement when a glass plate was placed upon the sac, gave the following response to stimulation of the nose with the glass rod.

"A rotation of the head slightly toward the

stimulus and a . . . flexion of the head away from the stimulus and (general) extension. In some instances the mouth opened, the forelimbs extended at the shoulder joint, and the back straightened; even the tail was extended."

The point so far has been that an asymmetrical stimulus, if it produces a result at all, produces an asymmetrical movement, the direction of which has a definite relation to the stimulus itself; this movement is followed by a symmetrical rhythm.

When the foetus is on its side, as is usually the case, gravity seems to become a component of tactile stimuli at about this stage, so that on stimulation the initial movement tends more and more to be one in which the crown of the head is directed upwards. The movements of the legs too are characteristic.

In fact by the 47th day, if the foetus is tapped vigorously either on the snout or the tail it will make a movement, which suggests an effort to get up, followed of course by the rhythm. On the subsequent days this aspect of foetal activity becomes very much accentuated till about the 50th day, when the movement produced by tapping the foetus closely resembles that often made when a new born lamb rises from the ground, rising on its forelegs and subsequently raising its hind quarters. (Later the lamb rises in a rather different way, getting on its fore knees, and then raising the back of its body and getting on to its hind feet before it gets one to its fore feet).

Seeing that this righting movement and the subsequent rhythm are parts of the same original complex, it is not surprising that the frequency and force of the rhythm should depend upon the vigour of the righting movement.

About the 49th day so lively is the foetus that it is difficult to manipulate it at all without consequent slight movements taking place, each followed by a rhythm. The result is that rhythmic movement scarcely ceases, and the foetus presents the general appearance of an ordinary animal breathing naturally; but when energetic movement takes place as the result of a considerable stimulus, as with a rod, the rhythm quickens and deepens, giving the appearance of an animal out of breath as a result of the effort it has made.

With these facts in mind it is interesting to re-read the paper of Krogh and Lindhard (1913) on "The regulation of respiration and circulation during the initial stages of muscular work."

The authors show conclusively that immediately on effort there is a quickening and deepening of respiration,—the same picture as is shown by a foetus of 49 days. In their words "evidence is brought forward to show that the rise in ventilation . . . is not produced reflexly but by irradiation of impulses from the motor cortex." This irradiation seems not to be the making of contact between two mechanisms primitively independent, but rather the removal of some factor which has dissociated two parts of a mechanism primitively one. This irradiation rather than any chemical mechanism would appear to be the fundamental regulatory mechanism.

After the 50th day, approximately, a great alteration takes place in the properties of the foetus, and all its reflexes become more difficult to elicit. On application of a glass rod it remains comparatively quiescent. We have come to an end of a definite stage of development: we do not know how these reflex activities become covered up, though several obvious suggestions present themselves. They are "covered up" however, and not really destroyed: this is shown by the fact that they can be brought out by subjecting the foetus to the appropriate degree of asphyxia.

Take a 68 day foetus (Sheep 149). That it suffered from oxygen want was shown by little haemorrhages on the skin which can be brought on by pinching the cord; moreover it was receiving blood along the umbilical vein with an oxygen saturation of 27%. It was as lively as the normal 49 day foetus.

It may seem remarkable that so little mention has as yet been made of occlusion of the umbilical cord. The fact is that up to this time (49 days) pinching the cord does not initiate respiratory movements. It has no other effect than to slow the heart and kill the foetus. The earliest effects of umbilical occlusion on respiratory rhythm were seen in a 48 day foetus such as we described in which it was otherwise impossible to reduce the embryo to such a degree of quiescence as to abolish the rhythm. Occlusion of the umbilical cord did this: the rhythm stopped when the cord was pinched and went on again when the cord was released. It would seem, therefore, that the effect of oxygen want on the sheep's foetus at about fifty days is much the same as that found by Rosenfeld and Snyder on the foetus of the rabbit even when pregnancy was artificially prolonged.

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THE NERVOUS SYSTEM[1]

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The lower creatures do not meet to discuss the factors which determine their behaviour. 'Know thyself' is a precept reserved for *homo sapiens*; indeed the more academic our discussion the better we shall demonstrate our true position in the animal kingdom.

We are animals with powers of reflection and foresight, who can use tools and form propositions. Our knowledge and attainments can increase from one generation to another because our children can learn from our successes and failures. In the last hundred years we have found out so much about the material world that we have acquired immense new powers of action on it. What have we found out meanwhile about ourselves?

There have been no practical achievements comparable to the radio set or the flying machine but no one can doubt that ideas about human behaviour are vastly different from what they were even 50 years ago. Our conduct is no longer as right or wrong as it was. We think of it still as the outcome of a conflict between opposing forces, but we do not postulate forces wholly good and wholly evil. In some lands they are now thought of as racial or class instincts: here we have more choice and are free, if we wish, to see ourselves driven by the more primitive forces which Freud has made respectable. But everywhere human behaviour has become something to be studied by the methods of natural science, as objectively as possible.

As a foundation to this study there is a mass of information about the mechanism of the body. The behaviour of any animal must depend in part on its general structure—its shape, size, number of limbs, arrangement of sense organs, etc., and with man there are the important structural modifications which allow the forelimbs to be used for wielding tools. Yet the chief factor which determines the range of our activities is the nervous system. Every movement is the result of the messages which pass from the central mass of nerve cells to the muscles, and the outgoing messages are varied according to the reports submitted by the sense organs. These show what is happening in the world outside and the central nervous system must evolve a plan appropriate to the occasion. But only the simplest plans are possible if the central nervous system is ill developed. The earthworm can take to its burrow when it feels the shock of footsteps on the grass and such an immediate reaction needs only a few hundred nerve cells and fibres; but we can sell out an investment when we hear rumours that the company is unsound and this reaction needs the ten thousand million cells of the human cerebral cortex.

Our concern is with behaviour of this characteristically human type. It represents by far the most complex synthesis achieved by any nervous system. Neurology, therefore, is not to be blamed because it cannot yet analyse such a product into an affair of nerve networks and nerve impulses. But from one aspect human behaviour is an affair of networks and impulses; it may be useful to picture it in these terms in spite of the fact that we know far more about our thoughts and actions than we do about the mechanisms in our brains.

The central nervous system may be divided into the forebrain, the cerebral hemispheres which elaborate the general plan of behaviour, and the brain stem and spinal cord which have to carry out the plan and attend to the administrative details. The whole system is made up of cells with thread-like extensions, some running as nerve fibres to the periphery and some forming the interlacing networks of the central apparatus. The cells and their extensions are excitable; within them are stores of available potential energy, ready to be discharged as soon as the restraining forces are weakened but replenished as soon as the discharge is over. All nervous activity involves discharges of this kind. Thus the long distance signalling from sense organs to brain and from brain to muscles is carried out by the conduction down the nerve fibres of repeated impulses, momentary waves of activity travelling like the spark along a fuse. And everywhere in the nervous system is liberated in brief outbursts rather than in a continuous stream. This fact by itself has little bearing on our actions, save that it sets an upper limit to the rate at which activity can change. What is of more importance is the fact that in some nerve cells the outbursts seem to occur spontaneously, without the need for an external stimulus to start the discharge.

The best example is the respiratory centre, the group of cells in the brain stem which controls the

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rhythmic movements of breathing. For these cells the normal state is one in which periods of rest and activity alternate regularly. There are various devices for controlling the rhythm and prolonging one or other phase to suit the convenience of the organism, but the regular cycle must return in the end, and it can occur, not from a sequence of reflexes, but from the cycle of breakdown and repair in the nerve cells. The movements of walking and running can be determined in the same way by an automatic rhythm in a group of nerve cells. With these, however, the organism has a greater measure of control and can start or stop the rhythm by the appropriate signals. The work of Coghill and others on the development of behaviour in the embryo has shown that many complex activities have this same semi-automatic origin, the outside world giving signals to begin and end and the organization of the nerve cells determining the general plan of response.

Admittedly there can be no real separation of activities which are spontaneous from those which are evoked by the environment. It is of interest none the less to find that the region in which spontaneous activity seems most ready to occur is in the great surface network of the forebrain—the cerebral cortex. Even in deep anaesthesia the cortex is alive with the electrical pulsations which are the index of nerve cell activity. They vary from a simple rhythmic beat to an irregular succession of waves. The latter are not merely a reflection of the irregular world outside, for the anaesthetic has cut off all incoming sensory messages; they are due rather to the automatic discharges of nerve cells, linked together, but differing in position and structure and in the past history of their activities. In these cells a steady state is impossible because their internal tension is constantly increasing to the point of discharge.

Although the cortex cannot be kept completely at rest for more than a few seconds, the degree of activity in it can vary enormously. The variations are due in part to the world outside and in part to the internal necessities of the nerve cells. Activity in one cell tends to foster activity in its neighbours and so to build up the general level of excitation. The level will rise until the process is checked by the falling reserves of available energy. Similarly rest breeds rest, and this process is checked by the internal tensions rising ultimately to the point of breakdown. The sudden increase of activity when we wake in the morning illustrates the change of level brought about by external stimuli acting on a recharged nervous system, though other factors are concerned as well. Inhibition, the process by which one cell can suppress instead of enhancing the activity of other cells, is no doubt a factor which helps to shift the focus from one part of the cortex to another. In general, however, we may think of the forebrain as a complex society of nerve cells, the units of which cannot remain for long either in intense activity or in complete rest.

These electrical changes give a picture of cerebral activity which recalls certain features of mental activity. The environment can start or stop a train of thought and keep it within certain channels, yet the sequence of ideas is often dictated almost entirely by past events and certain sequences seem to obtrude themselves unbidden. Such comparisons are dangerous, for they suggest that we have already a reasonable knowledge of the connection between mental and neural events, whereas in fact we know almost nothing. We can be sure, nevertheless, that the connection is extremely close.

The activity of the cerebrum, determined largely by the past and continually changing even in a steady environment is in sharp contrast with that of the rest of the central nervous system. This has no memory. Its function is to carry out the plans dictated by the cerebrum and at the same time to keep the machinery of the body running smoothly. It must regulate the intake of food and oxygen, the circulation of the blood, its temperature and acidity. It must keep the body in its correct position in space, balancing it in spite of its shifting centre of gravity. It must minimize the disturbances which are likely to result from great exertion or injury. For all this there is a beautiful reflex machinery coördinating the messages from sense organs specially adapted to register the blood pressure, the tension in muscles, the pull of gravity, etc. But an animal without its cerebrum is no more than an automaton: it can stand and breathe and live after a fashion, but its behaviour is reduced to a number of reflexes or, at the most, habitual patterns of action.

Long ago Claude Bernard insisted that the internal environment must be constant if life is to be unrestricted. His dictum has been supported lately by two distinguished physiologists from the two Cambridges. Cannon has shown how the visceral nerves prepare the body for sudden emergencies and Barcroft has studied the factors which lead to a breakdown of normal activity. It is significant that man has more need of a constant environment than any other animal, since it is the cerebrum which has the most delicate organization and can least withstand any change.

Human behaviour, then, is preeminently the affair of the cerebral cortex. This is made up of the same structures as the rest of the nervous system though there are more nerve cells in it, larger networks, in proportion to incoming and outgoing pathways and more spontaneous discharge. What is new is its power to combine past activity with present. As Sherrington has said, "The great new surface net of the brain is

educable. Before it, truly, there were educable systems in the animal world but this is so educable as to be practically a new thing in the world. In the dog it can acquire new links even in a few repetitions and links can be combined even to the third degree. In man it seems they can develop almost without limit."

The cortex can learn and can use its learning to generalize and to solve new problems. But even the simplest kind of learning involves a factor which must still be expressed in psychological terms. As Pavlov's work has shown there must be interest, a prospect of reward or punishment, an emotional stress which will change to satisfaction when the lesson is learnt or the problem solved.

We are still quite ignorant of the neural changes which take place when new associations are formed in the brain and we can only guess why an incentive is necessary. Twenty or even ten years hence we shall know much more, for there are definite changes in the electrical activity of different regions when we direct our attention from the visual field to the auditory and vice versa. These are not beyond analysis. It is perhaps too much to hope that in revealing the neural mechanism of attention they will reveal that of consciousness as well, but at least they may show what kind of influence is exerted by emotional interest and why that influence is exerted on particular mental and neural sequences.

We may guess that the state favourable to learning involves an increase of excitability and possibly a change in the chemical environment of those parts of the brain in which the new connections are established; and probably it is brought about by the more primitive parts of the forebrain, the hypothalamus and the basal ganglia. These regions prepare the nervous system for its cycle of sleep and waking; they are linked with the hormone system and they control various kinds of instinctive and emotional behaviour. Sinister proof of their importance comes from cases of injury or disease. But whatever the regions concerned, it is safe to assume that there must be some activity on the emotional or instinctive level to direct the attention and prepare the brain for new associations.

For discriminative behaviour, therefore, there must be some interest; yet if there is too much the behaviour will cease to be discriminative. Under intense emotional stress the behaviour tends to conform to one of several stereotyped patterns. These are managed by the more primitive parts of the forebrain and the cortex has little to do with them beyond directing the behaviour towards a particular object. Bard has shown that a cat whose cortex has been destroyed may give all the signs of rage, though it is a blind rage and useless to the animal. With the brain intact the rage is directed. It is still a stereotyped response, but it is often the best response for the cat to make since its cortex has not the capacity to plan more elaborately. In man, however, the cortex, when it is allowed free play, can be far more potent, and emotional reactions which force the behaviour along one line and allow no scope for discrimination are far less so. Moreover emotional reactions tend to spread through all the members of a group and to build themselves up to higher and higher levels.

There is no need to pursue a devious argument to its certain but commonplace conclusion—that our behaviour will be most effective when there is enough emotional tension to arouse the activity of the forebrain but not enough to submerge it in a stereotyped response. We know well enough that our emotions can cloud our judgment and the psychologists have shown that they do so far more than we suspect. We know that some interest is necessary, that moral indignation supplies the driving force for great reforms but that rage does not help them. Need we care greatly whether the neurologists can produce a scheme of nervous mechanism which will account for these things?

Most of us, I think, would welcome the knowledge gained but we might reasonably doubt whether it would make us more effective units of society. It is, in fact, unlikely that neurological research will give new methods of control over human behaviour. What it will certainly do is to improve some of the methods which exist already—for instance the control of behaviour by drugs. Tea and alcohol are homely examples, and the new narcotics which can give peace of mind before a surgical operation have shown what we may expect in the future from this method of regulating our brains. For more continuous action there are the drugs which the body manufactures for itself—the hormones. These, fortunately, have a place reserved to themselves in to-day's discussion.

But when all is said a knowledge of physiology offers only one certain, though perhaps unattainable, method by which human behaviour could be improved. That is to breed men with larger brains. Our cerebral hemispheres are not so much larger than those of the chimpanzee and contain no new structures, but our behaviour is of a different order. We can pile one box on another without thinking! Professor Köhler's chimpanzees could succeed by chance but the essentials of the problem were quite outside their mental range. It is tantalizing to think of the new relations we should see, of the new world of thought we should live in, if our brains were but twice their present size. Our behaviour would then be superhuman! It would be determined by the same physiological factors, but the importance of the cortex would be so magnified that the result must be beyond the power of human thought.

DETERMINATION IN THE EARLY DEVELOPMENT OF THE SEA-URCHIN

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The sea-urchin egg has been one of the classical objects of experimental embryology since the days of Hans Driesch, Theodor Boveri, Curt Herbst and Thomas Hunt Morgan, when these investigators in the '90s and the first decade of this century worked at the Zoological Station of Naples. Especially the results and concepts of Hans Driesch aroused a world-wide interest and exerted a great influence upon biological thinking. Driesch isolated fragments of early cleavage stages by shaking in calcium-free sea water. He came to the conclusion, that the sea-urchin egg is a harmonic equipotential system; that is to say, that practically every fragment could develop into a whole larva. Let us take this vitalistic idea of Driesch as a background and see what results we will get with more modern technique—the glass needles of Spemann combined with the calcium-free sea water of Herbst, the local vital staining of Vogt, and some specific methods for cutting, staining and transplantation.

Before we proceed to experiments we need fairly thorough knowledge of the normal development of the sea-urchin (Fig. 1). The first two furrows are meridional, the third equatorial, dividing the egg into eight equal blastomeres. But sometimes the third furrow cuts through further toward the vegetative pole and as a consequence the four animal blastomeres will become larger than the vegetative ones and will thus contain a part of the material really belonging to the vegetative half. The next cleavage is unequal, giving us one ring of eight animal mesomeres, four big vegetative macromeres, and four small micromeres. In the 32-cell stage the animal half consists of two rings of eight cells each, which are designated as an_1 and an_2. In the 64-cell stage the macromeres have divided into two rings of eight cells each, which we call veg_1 and veg_2. Thus we can divide the egg into five layers—an_1, an_2, veg_1, veg_2 and the micromeres. The blastula soon acquires active cilia. At the animal pole we find an apical tuft of long stiff cilia. Even before gastrulation the material derived from the micromeres migrates into the blastocoele as the primary mesenchyme, which will later give rise to the skeleton. At gastrulation, contrary to the old view of Boveri and von Ubisch that the whole vegetative half invaginates, only veg_2 will invaginate to form the archenteron. At the tip of the archenteron the secondary mesenchyme and the coelom are budded off. At this stage we find the first traces of bilateral symmetry, as the one side of the gastrula is flattened and thickened to develop into the oral field, surrounded by the ciliated band. At this side we find also two spicules, the first rudiments of the skeleton. From the oral field an ingrowth of the ectoderm forms the stomodaeum, which joins the tip of the archenteron. The archenteron is divided into oesophagus, stomach and intestine. By interaction of the ectoderm and the primary mesenchyme cells the four arms are formed, supported by skeleton rods. The egg axis in the fully developed pluteus is indicated by the stippled line in the last drawing of Fig. 1.

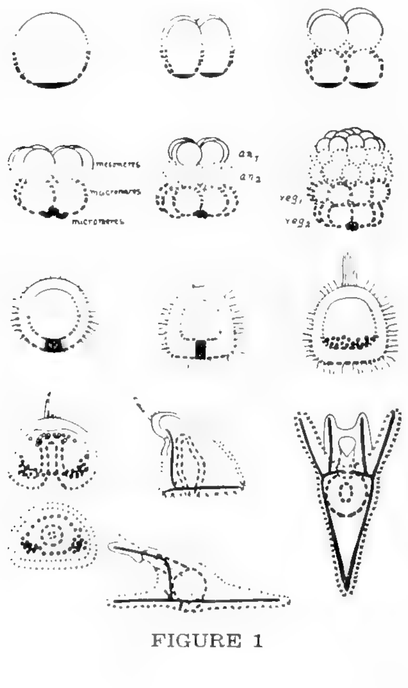

FIGURE 1

Zoja, Terni and von Ubisch have already shown that the isolated animal half does not gastrulate. If we study the isolated animal half closely, we will find that the majority of cases show a greatly enlarged apical tuft, covering up to about three-fourths of the surface. Others have a smaller apical tuft and there are all kinds of intermediate stages down to some animal halves with a normal apical tuft. A couple of days later those with a very large apical tuft develop into uniformly ciliated blastulae. Those with a slightly smaller apical tuft produce blastulae with a ciliated field. Others form blastulae with a ciliated band, and those with a normal apical tuft develop into blastulae with a ciliated band and a stomodaeum, without any trace of an archenteron. The vegetative halves

also show different types. Most of them are somewhat ovoid, without mouth and arms and with a very irregular skeleton. Others more or less resemble typical plutei.

To interpret these phenomena we will adopt the hypothesis suggested by Runnström, that there exist in the sea-urchin egg two overlapping gradients, one animal and one vegetative, which interact mutually and are partially hostile to each other. Let us see what kind of regulation takes place in the isolated vegetative halves. Since we have taken away two-thirds of the presumptive ectoderm we ought, according to Driesch, to get an ectodermization of the presumptive entoderm in order to get a harmonic larva. But the contrary takes place: instead the animal gradient becomes partly suppressed by the vegetative, so that a part of the presumptive ectoderm becomes converted into entoderm. If we rear the animal and vegetative halves from one egg together we will find that, roughly speaking, the animal half with enlarged apical tuft corresponds to the best developed vegetative halves; whereas the more richly developed animal halves correspond to the more poorly differentiated vegetative halves. This we explain as follows: The animal halves with stomodaeum and ciliated band came from eggs where the third furrow was translocated towards the vegetative pole. The material they have thus obtained from the vegetative half inhibits the extension of the apical tuft and causes the formation of the stomodaeum and ciliated band. On the other hand the lack of the most animal part of the vegetative half accounts for the poor development as regards the ectoderm and skeleton of the vegetative half. That this view is right we can prove by the following experiment.

If we take eggs of a type, which produce animal halves with very enlarged apical tufts and, later, ciliated blastulae and isolate the entire presumptive ectoderm ($an_1 + an_2 + veg_1$), we find that this fragment always develops into a larva with a normal apical tuft, ciliated band and stomodaeum (Fig. 2). This experiment shows the power of the veg_1 material. If instead of veg_1 we add veg_2 to the animal half, we obtain a perfect pluteus. Thus veg_2 forms the archenteron, in accordance with its presumptive significance, and also has the power to inhibit the apical tuft and bring about the formation of a ciliated band and stomodaeum; moreover, by regulation it forms a skeleton.

If four micromeres are implanted in an entire presumptive ectoderm ($an_1 + an_2 + veg_1 + 4$ micromeres) (See Fig. 2), we obtain perfect plutei. The micromeres themselves form the skeleton and have induced an archenteron. The same thing happens if we implant the micromeres in an animal half. The micromeres also have the

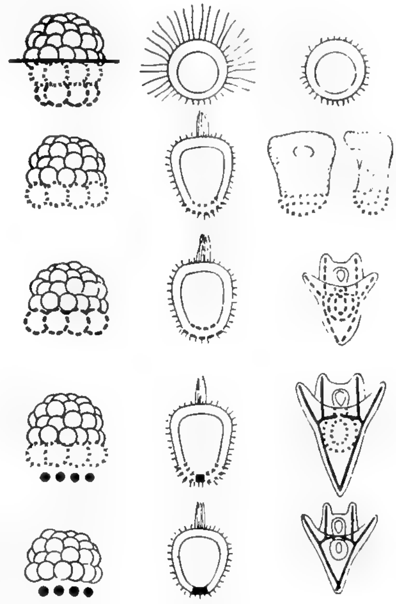

FIGURE 2

power to inhibit the apical tuft and to cause the formation of the ciliated band and stomodaeum. The entodermizing power of the vegetative material can be shown in many ways; for instance, by adding an animal half to a meridional half. A larva so produced has the volume of a normal larva but only half the vegetative material of a normal egg. By vitally staining the animal half we can follow the entodermization which produces a perfectly typical pluteus.

If we greatly diminish the vegetative material, thus leaving the animal half in contact with only two macromeres and two micromeres;—or two macromeres without micromeres; or one macromere and one micromere; or only one macromere; or only half a macromere (Fig. 3);—we find entodermization in the first four cases, stronger when the micromeres are present, but only proportionate to the vegetative material. The smaller the amount of vegetative material, the smaller also the amount of entodermization. That is contrary to what we would expect according to Driesch and in the last-mentioned experiment, an animal half plus a half macromere, we sometimes find that the presumptive entoderm of the half macromere cannot express itself. It is ectodermised (Fig. 3).

One of the main principles emerging from this work is that the development of a typical larva out of a fragment is due, not to the absolute amount of animal or vegetative material present, but to the relative amount. This may be illustrated by the following experiment. If we assume

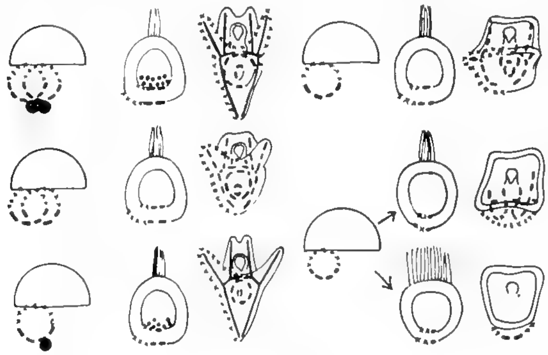

FIGURE 3

that in the last-mentioned experiment the suppression of the presumptive entoderm has been caused by the animal gradient, we ought to get normal development if we diminish the animal forces: that is to say, leaving only a few animal cells (instead of the animal half) in connection with the half macromere. This, as a matter of fact, always gives us a good larva with digestive tract and skeleton. Now the presumptive entoderm in the half macromere is not suppressed any more but is able to express itself and to form not only entoderm but also skeleton. The same principle is altered also by the fact that if we fill animal halves or entire eggs with micromeres, they will develop to ovoid larvae which look like vegetative halves.

If we now isolate the four layers spoken of before, we find an illustration of the gradients. The whole surface of an_1 is covered with long stiff cilia, an_2 only to about 3/4 of the surface; veg_1 may tardily acquire an apical tuft and then develop into a ciliated blastula, or it shows no apical tuft but still later develops a small archenteron. (Fig. 4). Veg_2 is very interesting. It gives us ovoid larvae with large bi- or tripartite archenteron and one or two small spicules. Here for the first time we get in a vegetative fragment ectoderm formed by regulation, from presumptive entoderm. This means a more animal differentiation than is suggested by the prospective significance of the material. At the same time, the skeleton is a more vegetative differentiation. This illustrates another main principle shown by many of these experiments: reorganization of the gradient system that takes place in fragments leads to a stronger concentration of the gradients at both poles of the fragment than before.

Another interesting feature of this veg_2 larva is the poor development of the skeleton. We have seen in Fig. 2 that veg_2, together with the presumptive ectoderm, can give a good skeleton for a whole pluteus. Here the skeleton is very poor. This is not because of lack of skeleton material, but for lack of enough animal properties of the ectoderm which has been formed by regulation. The whole larva is too vegetative to develop a good skeleton and normal ectodermal differentiations.

If we add one or two or four micromeres to veg_2 (Fig. 4), the larva will be too vegetative to gastrulate. It forms an exogastrula. Four micromeres together with veg_1 will give us a larva of the same type as veg_2 isolated. Thus veg_1 plus four micromeres seems to have the same constitution with regard to the gradient system as veg_2 isolated. In order to get the most pluteus-like larva we have to take veg_2 isolated, veg_1 plus one micromere, an_2 plus two micromeres, or an_1 plus four micromeres. An_1 plus one micromere is highly interesting. The micromere first checks the apical tuft; later there is the struggle between the gradients, which results in the defeat of the vegetative forces of the micromere. The apical tuft enlarges and the animal forces suppress the vegetative, so that no indication of an archenteron appears, nor can the primary mesenchyme cells produce a skeleton.

The gradients can also be illustrated in the following way. If we implant four micromeres in the animal pole of an entire egg, we get only a very small archenteron induced. If we put the micromeres between an_1 and an_2, the archenteron will become larger, bi-partite, and there will be supplementary skeletons on the sides. If we place the micromeres between an_2 and the vegetative half, a still larger archenteron will invaginate at the point of implantation, but this one will later fuse with the normal archenteron.

Another experiment showing the struggle between the gradients involves the removal of the micromeres from the vegetative pole and their implantation into the animal pole of the same egg. In that case we have added nothing to the egg, only translocated the micromeres from one place

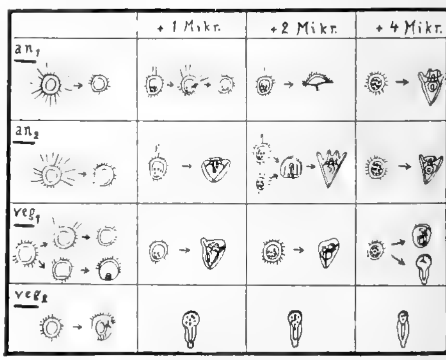

FIGURE 4

to another, resulting in an enlarged digestive tract and a considerably enlarged coelom. In this case the implanted micromeres do not induce an archenteron but they weaken the animal gradient so as to allow the vegetative gradient to express itself further towards the animal pole. The same explanation holds for some other cases when four micromeres are implanted into the animal pole of an animal half. In this experiment we sometimes obtain larvae with two archentera, one induced at the animal pole by the micromeres, one formed at the most vegetative part of the animal half. As isolated animal halves never gastrulate, this invagination of the vegetative part of the animal half seems also to be due to a weakening of the animal gradient by the micromeres. The most animal region of these larvae is situated between these two vegetative centers; here we find the apical tuft. In other cases there may be no invagination at the vegetative side of the animal half, but only at the point of implantation. A skeleton and stomodaeum are differentiated in accordance with this animal archenteron and the apical tuft may be developed at the most vegetative part of the animal half, which now constitutes the new animal pole. This means that we have in this animal half a complete reversal of the polarity of the egg axis, brought about by the micromeres.

We now turn to the determination of the dorso-ventral axis, that is, the bilateral symmetry. This axis is not so stable as the egg axis. It can be influenced by stretching or centrifuging the egg (Boveri, Runnström, and Lindahl). We are not going to deal with experiments of that kind. Our problem will be to study whether there will be a bilateral organization in the early stages of development, traces of which we may recognize in meridional fragments. We know by vital staining that the first furrow may divide right halves from left, or dorsal from ventral; or it may pass obliquely to the median plane. We isolate half blastomeres, and when they form, in an early cleavage stage, open half blastulae, we stain the cut side by leaning it against a piece of agar. In some pairs we evidently have to deal with right and left halves with complementary deficiencies of the skeleton and arms of the stained sides. In other pairs both larvae are stained on the dorsal side, but one is ahead in development as regards differentiation of the ventral side (ciliated band and skeleton). As the dorsal half is also stained on the dorsal side, the dorso-ventral axis must have been reversed. Then we get many pairs where larvae are stained obliquely, dorsolaterally. Sometimes the cut, stained side is less well developed than the other one, but sometimes it is better developed. These different types may be explained by the fact that the furrow has passed more or less obliquely, and that in the most dorsal partner the dorso-ventral axis may be reversed, or may be rotated slightly. We cannot exactly analyze these factors, but they probably account for the different types of development in the pairs that we obtain.

If we isolate the four blastomeres of the four-cell stage in four dishes in such a way as to know which of the cells have been neighbors to each other, we often find in the development of these quartettes that two of the larvae, the ventral ones, develop their ventral side faster and better than do the other two, which we designate as dorsal. In other cases we may find one ahead of the other three or one decidedly the best, whereas the opposite one develops still more slowly than the other two. In these cases we obviously have to deal with one ventral, one right, one left, and one dorsal blastomere. The great majority of the quartettes in this way indicate a bilateral organization in the early cleavage stages.

If we divide the egg into eight meridional parts (with the exception of the micromeres which have to be first removed) we find that such small fragments may give rise to plutei. Whether some of these small larvae which we isolated in the right order of sequence correspond to the ventral, others to the dorsal, side, is not easy to determine.

The old problem of whether the egg is bilaterally organized before fertilization can be approached by dividing the egg into meridional halves (orienting by the aid of the pigment ring in Paracentrotus eggs) and subsequently fertilizing the two halves. One will of course be haploid. Some pairs show complementary deficiencies on the right and left sides. Others differentiate like ventral and dorsal halves; there are cases where the diploid partner is the better developed larva (designated as ventral), but also cases where the haploid partner, which always develops more slowly than the diploid, clearly shows itself to be ventral.

Schleip, Runnström and Lindahl have suggested that the cause of bilateral symmetry would be that the vegetative gradient would be stronger on the one side than the other. There are many facts in favor of this view, but it is untenable since the dorso-ventral axis is reversed in the dorsal halves. According to the view in question, the dorso-ventral axis ought to be kept in the dorsal half. There are some indications that we have in the sea-urchin egg two fields of high activity, one larger on the ventral and one smaller on the dorsal side. We may suggest that in the dorsal half the new ventral side (the old dorsal field) may have about the same properties in relation to the cut, new dorsal side as has normally the ventral field to the dorsal.

Tyler has shown that the smaller a larva is, the more energy is required to bring it to a certain stage of differentiation. He suggests that the fact

that small fragments (isolated eight-blastomeres) cannot gastrulate is due to lack of energy. But we have seen that fragments a little smaller than one eighth of an egg can develop into a pluteus. This is due to the fact, that in this case the animal and vegetative forces are present in nearly normal proportions, which they are not in isolated right-blastomeres. Tyler has further shown that giant eggs composed of two fused eggs develop faster than normal ones, although we must presume that regulation takes place in them. Tyler means that the well-known retardation of development of fragments is not due to regulation, as has always been believed, but to energy conditions. We have clearly seen from the development of half and quarter larvae, that there is a regulation of the dorsal fragment which requires time. It is possible, however, that both views may be combined, that there is a general delay in fragments due to energy conditions, and, moreover, a specific delay, more marked in dorsal fragments, due to regulation.

The Echinoderm larvae have a marked bilateral asymmetry, the hydrocoele (which gives rise to the ambulacral system) developing on the left side. This asymmetry was studied in the starfish larva. If such larvae were divided into right and left halves at an early stage, the left halves always developed a hydrocoele on the left side, but in the right halves we could get a hydrocoele on the left side, the right side, or on both sides. This may also be explained by two opposite gradients, the left stronger than the right. It then appears to depend upon the relative strength of the gradients, whether in the right half the left or right will be the stronger, or whether they will be equal.

Let us finally study how determination proceeds in time. If we isolate animal halves every second hour from the 16-cell stage (4 hours after fertilization) up to the beginning of gastrulation (16 hours after fertilization) we will find, both as regards the apical tuft and the differentiated organs (ciliated band and stomodaeum), that the animal half seems to become fully determined comparatively early (about 8 hours after fertilization). But if we isolate only the most animal fourth of the egg, corresponding to an_1, we find the determination not completed until 14 or 16 hours after fertilization. This means that the determination proceeds from the vegetative towards the animal pole. The isolated vegetative half shows the different types which we knew before (ovoid larva - pluteus) until we get to 14 or 16 hours after fertilization, when suddenly a new type appears, a pluteus with long, anal arms, but completely without oral lobe. Thus also regarding the vegetative halves determination seems to be complete at about 14-16 hours. The same holds for right and left halves. At 10 hours, for instance, the complementary deficiencies are much more marked than at the early stages we studied before. A beginning gastrula, divided into right and left halves, differentiates into two half-plutei, looking exactly as if one had cut an already differentiated pluteus into two halves. The dorsal and ventral partners, isolated at about 10 hours, show different types, some of which reverse the dorso-ventral axis completely in the dorsal partner. A skeleton is sometimes formed, not only on the new ventral side, but also on the new dorsal side. Others with two pairs of skeletons may not reverse the dorso-ventral axis, but form a ciliated band and mouth on the presumptive most ventral part. Thus it seems as if at this stage the dorsal halves do not quite know how to develop. If we cut still later, at the beginning of gastrulation, the dorsal and ventral halves also develop exactly like dorsal and ventral parts of the pluteus.

If we isolate a great number of animal halves in the 16-cell stage (4 hours after fertilization) and implant micromeres, in some of them immediately, in others 2, 4 and up to 12 hours later, (that is, 6 to 16 hours after fertilization), we obtain different types of larvae—typical plutei with small digestive tracts; larvae with an archenteron that does not reach the stomodaeum; blastulae with ciliated band, stomodaeum, skeleton and arms; the same kind of blastula but without arms; blastulae with skeleton and ciliated band; ciliated blastulae with small spicules. These different types occur in a certain specific order of sequence in relation to the time of implantation. The later the micromeres are implanted, that is to say, the longer the animals have been lying isolated before implantation, the less they will be open to the inducing influences of the micromeres. Already six hours after fertilization the plutei will have a small digestive tract only; at eight hours few gastrulate any more, the majority are blastulae with skeleton, arms, and stomodea. At 14 or 16 hours we find only ciliated blastulae with small spicules inside. If we now, on the other hand, instead of isolating in the 16-cell stage, isolate at 4-16 hours after fertilization and immediately implant the micromeres, we find that the animal halves will be able to respond to the induction at a much later stage than in the former case. The same difference holds also for the action of lithium on the animal halves which have been lying isolated some time before being put into lithium compared to those which were isolated at a later stage and immediately brought into lithium. Thus the animal half develops faster in an animal direction when it is isolated, than when all the time connected with vegetative material.

All these experiments have shown that the sea-urchin egg is not a harmonic equipotential system

in the sense of Driesch, nor are the organs fully pre-formed. We find systems of gradients and fields of different activity, and we find that differentiation is due to the interaction of these different parts of the egg.

With operative methods it is possible to map out the prospective significance of the different egg regions, to find out the potencies of small regions when they are isolated, and when combined with other parts of the egg, thus revealing the interactions between the different regions. But we can never get to the processes behind these phenomena. Here the cell physiologist has to continue. A good start in this way has been made by the Echinoderm school of Stockholm, as it has been called, under the inspired leadership of Dr. Runnström. It is to be hoped that future work in this field will give us valuable contributions to our knowledge of development.

(This article is based upon a lecture presented at the Marine Biological Laboratory on July 31).

DISCUSSION

Note: Dr. Hörstadius' lecture was discussed informally on August 14 by a group of workers at the Marine Biological Laboratory, including Dr. T. H. Morgan, Prof. Douglas M. Whitaker, Dr. P. B. Armstrong, Dr. Oscar E. Schotté, Mr. A. B. Novikoff, Dr. B. H. Willier, Prof. Ralph S. Lillie, Prof. Robert Chambers, Dr. Ethel Browne Harvey, Dr. Henry J. Fry, Dr. C. T. Kaylor, Dr. Felix Bernstein and Prof. B. H. Grave. The following is not a verbatim account of the discussion, some parts having been left out because of minor interest and others because they would be impossible to understand without the drawings and slides that were used. Professor Chambers acted as chairman.

Dr. Chambers: To what extent do you find totipotency in the unfertilized sea-urchin eggs of European forms? As I understand, you have worked with a form which can be readily oriented because of the presence of a pigment band about the ovum.

Dr. Hörstadius: Yes, Paracentrotus. We have along the egg axis of the ripe egg even before fertilization animal properties, the presumptive ectoderm, occupying the upper three fourths of the egg. If we speak of totipotency it is a little bit difficult to define that picture. These three fourths can give everything—but they cannot do it by themselves. They may produce ectoderm, but also entoderm if that is induced. And the lower part of the egg, which ordinarily gives entoderm, can also give ectoderm under certain circumstances. As a matter of fact, it seems that every part of the egg can give everything, but not by its own power.

Dr. Whitaker: What do you get if you remove merely the micromeres and let all the rest of the blastomeres remain together?

Dr. Hörstadius: You get a perfect pluteus, because the skeleton-forming material goes up a little higher than the material that normally forms the micromeres.

Dr. Whitaker: Will you explain what you mean by "regulation"?

Dr. Hörstadius: I mean redistribution of the gradients to produce a gradient system which will, as much as possible with the material present, resemble a normal one.

Dr. Schotté: Will you please reconsider with us the problem of the "organization center" in the sea-urchin egg, which you spoke of in your paper in 1928?

Dr. Hörstadius: In that paper I spoke of an organization center at the vegetative pole of the egg, because if we isolate the animal half, which ordinarily gives stomodaeum and ciliated band and arms, we don't get that out of the animal half. Thus it seems as though something emanating from the vegetative half has not been able to reach the animal part. That is one of the factors that Spemann requires for an organization center. If you put micromeres into an animal half you get a whole pluteus. This resembles very much the organization in the amphibian egg. Shortly after, Runnström suggested the idea of the double gradient system of forces partially hostile to each other because of the activities which I have shown here, and the experiments he himself performed with lithium, concerning the animal forces in the egg.

Now what about the organization center? We cannot use the word "center," but we could, if we wanted to, speak of two organizers, animal and vegetative. But I think it is better to speak in terms of gradients in this case.

If we cut between the animal and vegetative halves and turn the vegetative half upside down, the vegetative part will form a small blastula and the animal will sit as a cap on top of the first. Then the small vegetative blastula opens into the cap and we get just one round blastula in which the most vegetative material is now located immediately under the equator. Gastrulation starts with this most vegetative material. The result will be a pluteus with a sort of gastrula hanging outside the anus. This gastrula is derived from the presumptive ectoderm and a part of the presumptive entoderm of the reversed vegetative half. The entoderm of the pluteus also comes from the vegetative half. Here the animal half has incorporated a part of the presumptive entoderm of the vegetative half reversed at the operation, thus actually reversing the polarity of the incorporated part. In that way the animal half acts as an organizer, if you wish to say so, upon the vegetative.

It is necessary to have a certain amount of animal influence to get the formation of ciliated band and stomodaeum; if a larva is too vegetative, they won't be formed. On the other hand, if an animal fragment is too animal, these organs won't be formed either, although the prospective significance of that material is to give ciliated band. If we now add micromeres to the animal half we get a pluteus with mouth, oesophagus, stomach, intestine, skeleton and everything. Now the micromeres have caused the formation of these organs. I think that might be called induction as regards the archenteron. Do you think so?

Dr. Schotté: I think so.

Dr. Hörstadius: But if we now, instead of adding the four micromeres to this animal half, add, let us say, 12 or 16 micromeres, we get too much of the vegetative power and the whole individual will look like a vegetative half of an egg which very often produces no mouth at all and only a poor ciliated band. If we thus put too much of this inducer into the animal half the organ which will be induced by a smaller amount will disappear again. Is that induction?

Another thing. Let us now put the micromeres, not down on the vegetative side, but up at the animal pole of the animal half. In that case we sometimes get an archenteron at the animal pole, but also one at the vegetative pole. We see by vital staining which are the two poles. The animal archenteron has been induced by the implant but this has also caused the formation of the vegetative one, but a long distance from the other pole. Is that induction? It is easy to explain with the assumption that the animal gradient is weakened when the micromeres are implanted in the animal pole. and moreover it is so much weakened that the vegetative gradient which we always have in the animal half, but more or less suppressed, is now able to form another archenteron. I first thought this quite strange, but when we think in terms of double gradients it seems quite natural. Whether this agrees with the term induction in its ordinary sense I do not know.

Dr. Schotté: By induction we generally understand formation of something essentially different from what has been implanted. The micromeres do not normally form the archenteron. Therefore, if by their implantation a new archenteron is obtained we have there a clear case of induction. But the differentiation of a second archenteron at the opposite pole of the implant cannot be understood in the sense of a normal Spemann induction but must be related to what you say: that the embryo as a whole starts to influence this region and a weakening of the animal influences occurs. We have nothing similar in Amphibia.

Mr. Novikoff: Is it possible to use the other end of the system, that is to implant or transplant one of the ectoderm cells into the vegetative half?

Dr. Hörstadius: You can do that, but there, you see, the animal properties are not so concentrated and you add there a part of the material which will give itself the organs you want to produce in the vegetative half. It is rather hard to explain!

Mr. Novikoff: Suppose you take cells that would form the apical tuft, which cells do not have prospective significance of stomodaeum or ciliated band, and implant that into the vegetative half. Will that induce ectoplasmic structures?

Dr. Hörstadius: It will if the transplant is large enough and strong enough. But it is very hard to do. In the micromeres you have small cells which are very strong. In the animal half, the forces are more diffuse and so it is difficult to do such experiments. You can do it more easily in a chemical way—get an ectodermization of vegetative material as Herbst and Lindahl have shown. If you put the eggs before fertilization into calcium-free sea water with sodium sulfocyanate it is possible to make a whole egg develop like an animal half, to give only a large apical tuft and ectoderm.

Dr. Lillie: How do you use it?

Dr. Hörstadius: You put the eggs in calcium-free sea water and ten per cent isotonic solution of NaI or NaSCN for about twenty hours before fertilization, then you wash the eggs and fertilize. If you afterwards isolate e.g. the most vegetative quarter of the egg, the presumptive entoderm- and skeleton-forming material (which isolated gives an exogastrula without any skeleton because it is too vegetative), you get from that most vegetative quarter of the egg some different types. Some look like completely normal plutei!

Dr. Harvey: Cannot these animalized halves be considered just as an arrested development, just blastulae that do not develop further?

Dr. Hörstadius: Not for several reasons. If you have normal larvae, first day after fertilization, say it is a gastrula with an apical tuft, and the second day it is a pluteus. If you isolate an animal half, the first day it has a very enlarged apical tuft and some small cilia. The apical tuft is much larger than normal, so it cannot be just a normal development of this part. Secondly, these eggs do develop further; the long stiff cilia disappear and afterwards you get just small cilia around. That is a further development, and most of them are perfectly healthy—no pathological cells at all. They swim healthily for a week. Then in other cases, where the first furrow is not equatorial but lower down, the animal halves may also give larvae with a ciliated field and pavement epithelium, or also larvae with ciliated band and stomodaeum. So we have different types of dif-

ferentiation and it is certainly a real development we have.

Dr. Armstrong: Are there other criteria besides differentiation by which we may demonstrate these two gradients? What is the nature of the gradient?

Dr. Hörstadius: Besides differentiation? Then we get into the physiological side of it. We can demonstrate in many of the slides I showed in the lecture the things I have been talking about. On the physiological side, if you are interested, I will mention a little of what has been done in that way in Stockholm by Runnström and Lindahl; some papers and preliminary notes are published and a large paper by Lindahl is in press. We know nowadays that in the animal half the oxygen consumption is higher than in the vegetative half, so there are metabolic differences. Carbon monoxide sensitizes to lithium; if you put the eggs in carbon monoxide in darkness, this will inhibit respiration, but, if you illuminate, that will be reversed; the sensitizing effect will decrease. Lindahl found that lithium alone will suppress to a certain degree the oxygen consumption. Warburg has shown that in the sea-urchin egg from fertilization on there is a gradual increase in oxygen consumption. Lindahl has found that, if you put eggs in lithium, there is only little decrease in oxygen consumption immediately after fertilization but the decrease is augmented during development. He also found that only one part of the respiration can be inhibited by lithium.

Dr. Schotté: Would that explain why animal and vegetative potencies manifest themselves, because the oxygen consumption at one or the other pole decreases?

Dr. Hörstadius: It would in a way. I will come to that. It has been found by Runnström that potassium antagonizes lithium so that if you add both K and Li to the sea water you will get very little lithium effect. Lindahl found that this adding of K also removes the inhibiting action of lithium on the respiration, so that here we have a parallelism between the metabolic changes and the morphological. Then we have these experiments with animalization which I mentioned before, the case of sulfocyanate. But this does not act in an animalizing manner if respiration is inhibited; if you put the eggs into a milieu of nitrogen for instance. And normal eggs respire more than entodermized ones.

Dr. Lillie: If you have animalized them in that way, do they respire more rapidly—have you manometer experiments, for example?

Dr. Hörstadius: Yes. The animalized eggs will respire more than the normal ones but, if you animalize the eggs and after fertilization put them into lithium (which will entodermize them), they will come back practically to normal oxygen consumption, as Lindahl has shown.

Dr. Whitaker: Do other respiratory stimulants tend to animalize—methylene blue or things like that?

Dr. Hörstadius: I don't know. But it can be done by sea water without sulfate ion. Then there is another thing also in the recent research of Lindahl. Herbst found this animalizing without sulfate ion (together with increased Ca) and he found that the sulfate ion is not necessary up to the blastula stage. The eggs could develop perfectly well up to the blastula without sulfate ion. Now Lindahl found also that up to the late blastula stage there is no change of the respiration of the eggs in sulfate-free sea water, but later from the blastula with mesenchyme inside there was about thirty per cent inhibition of respiration when the sulfate ion was absent. Thus both lithium and lack of sulfate ion inhibit respiration. If he combines these two, he finds that the effects are additive, and that seems to indicate that the inhibition by lithium belongs to another sort of reaction system than inhibition by lack of sulfate. And still further he has found that there is in the egg a phenol-sulfatase which seems to have the function of "de-poisoning" phenols when they are formed. But if the sulfate ion is missing, there won't be any "de-poisoning," the phenols will disturb the reactions, and the respiration is decreased. Lindahl explains the effect of the combined lithium and sulfate ion in this way: the vegetative reactions are inhibited by local poisoning by phenols if no sulfate ions are there; then you have lithium in the water also, which will prevent the extension of the animal tuft. But you don't find any entodermization, which we ought to have when there is lithium present, because the vegetative reactions are disturbed by the poisoning. Thus neither ento- nor ectodermization, only a considerable decrease in oxygen consumption occurs.

In this way Lindahl has been studying the physiological differences between the two systems. This is very hard to explain and to follow, I am afraid, but it may give you an idea of lines along which they are working to get at these things. I think it indicates that there are physiological differences which characterize the animal and vegetative parts. Lindahl comes to the conclusion, that the animal type of metabolism, with the higher oxygen consumption, probably has to do with the breaking down of the carbohydrates and manifests itself in that part of the respiration which can be inhibited by lithium, whereas the vegetative type for example has to do with the formation of phenol and another part of the respiration. A further support of this view is given by the following experiment by Lindahl (not yet published). Lack of sulfate ion has no effect on isolated animal halves—you remember that the

(Continued on page 265)

THE GENETICS SOCIETY OF AMERICA

PROGRESS IN CYTOGENETICS

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Judging from the past two years, these round-table discussions consist mainly of hand-to-hand battles, or "dog-fights." And the function of the so-called "introducer" is to throw bones to these dogs—the bones being highly controversial matters for them to fight about. But the introducer should have another function too—of setting the stage and reading the prologue, so that the non-dog members of the audience can know better what the fight is all about. For example, I am sure that lots of people here have never seen a salivary chromosome, though they may hope to see one, and certainly, once this "dog-fight" gets really going, they would rather see than be one.

What we mean by "progress in cytogenetics" is deeper knowledge of the relation between two aspects of life—one is the characteristics of developed organisms, and how these characteristics arise and are transmitted from generation to generation. The other is the machinery behind these phenomena, the physical structure of the living units responsible for this inheritance. Until about two years ago we could find out this relation faster by breeding methods—for example, by counting the kinds of children in families of flies—than we could by directly looking at the cell structure with the microscope.

What we saw by the microscope was chromosomes. Each cell of the female fruit fly has four pairs of sausage-like bodies called chromosomes, one of each pair from the father and the other from the mother. What we found by counting flies was that the determiners of the inherited characters—the genes—were also in four groups, the sizes of the four groups matching the sizes of the four chromosomes. Also that the genes must be assumed to be tied together end to end like chains—and the lengths of these four chains matched the lengths of the chromosomes.

But the internal distances within the maps were found not to correspond very directly with the internal distances along the chromosomes. In the middle of chromosome 2 a long section of the chromosome corresponds to a short section of the map, while, near the end, a little of the chromosome corresponds to much of the map. That fact tells us that the "coefficient of crossing-over" (which is the ratio of length of chromosome in a particular section to the length of map in that section) is a variable and is high for the end regions and is low for the attachment regions of the chromosomes.

There the matter rested until the salivary chromosomes were found and their huge size enabled us to make the relation of the map to the physical structure of the chromosome much more precise.

You will be hearing this morning about the structure of the salivary chromosomes, so I'll show you a photograph of pieces of them—in which you see dark crossbands and also longitudinal striations or threads running diagonally along the chromosomes.

Each of the large strands is made by the fusion or synapsis of the maternal and the paternal chromosomes. Each paternal chromosome is supposed to be compound, having several chromosomal threads which arose by splitting of the original single thread.

When the straightened-out salivary chromosomes are compared to the maps, the striking fact is that the over-all length of each map matches closely to the over-all length of the corresponding salivary chromosome. Even the internal correspondences match fairly well in the X-chromosome.

In comparing the end of the right half of chromosome 2, and the corresponding map, the coefficient of crossing over is seen to be about normal; i.e., 7 units of map distance between humpy and plexus correspond to the same length of salivary chromosome as do 7 units of map distance between plexus and speck. But here comes a distinctly new relation which it was only possible to deduce from counting the bands of the salivary chromosomes. You see that from humpy to plexus the same number of bands are present as in the sections from plexus to speck. But in the latter section are 15 mutants on the map against 3 in the first. That is, the coefficient of mutation is five times as high in the px-sp section as in the hy-px section.

I hereby throw the first bone to the dogs, in the contention that the reason for this difference in coefficients of mutation lies not primarily in the nature of the genes themselves but in the fact that in certain regions the genes are not represented only once but are also present elsewhere in the chromosome as a duplication. In the left limb of chromosome 2 are three such duplicating sections of large size.

Many such duplications are now known or suspected and their origin through unequal crossing-over has been ascertained in the case of bar. They may also arise through crossing-over between two inversions which are semi-homologous—that is, that fail to match exactly at one or both ends.

I was asked last night if anything of a startling nature had arisen recently in the salivary work,

and I answered that something so surprising had come up that I hadn't decided yet whether to believe it or not. It seems that in XXY females part of the so-called nucleolus—a very large faintly-staining structure—showed crossbanding and longitudinal striations apparently of the same type as the normal salivary chromosomes but much more diffuse and distended with matrix material. In the normal XX female the nucleolus is bag-like and vacuolated and it is probable then that two distinct structures, the true nucleolus and the nucleolus-like Y-chromosome, have been confused with one another. But this is only my working hypothesis and sadly needs immediate testing and checking by other material—especially with translocations involving the Y.

(This article is an introduction to a round table conference of the Genetics Society of America at the Marine Biological Laboratory on September 4, 1936).

GENETIC NATURE OF SPECIES DIFFERENCES

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The descriptive study of organic diversity may now be considered well advanced. Approximately 822,000 animal and 240, 000 plant species have been described and classified, and macroscopic as well as microscopic anatomy of representatives of main subdivisions of the living world has been investigated. The problem of organic diversity must now be studied in a new aspect, namely as a general property of the living matter.

The differences between any two individuals or species are due to the fact that they carry different genes. Each organism is characterized by having a definite gene pattern, and the gene patterns in different organisms may be unlike. This statement does not represent, however, an adequate solution of the problem of organic diversity, for it fails to take into account the striking fact that organisms are segregated into a finite number of discrete groups, species, which are prevented from interbreeding with representatives of other similar groups. In other words, the existing organisms do not form a freely interbreeding array in which all the possible gene combinations may occur; the gene patterns characteristic for each species are to a certain degree fixed, and exchange of genes between species is made difficult or impossible.

On the other hand, new gene combinations are constantly arising due to mutation and hybridization. Evolution may be described as a resultant of interaction of two opposing groups of forces: those tending toward fixation of the established gene patterns whose survival value has been tested by natural selection, and those tending to the production of new gene patterns.

Fixation of the established gene patterns is accomplished by a variety of causes preventing free interbreeding of species with each other. All such causes may be termed "isolating mechanisms." It is a remarkable fact that the isolating mechanisms which are observed in different groups of organisms are frequently different, and moreover that interbreeding of a given pair of species may be prevented by a cooperation of several isolating mechanisms.

As an example of this situation the case of the two "races" of *Drosophila pseudoöbscura* may be quoted. These "races," known as race A and race B respectively, are partly isolated geographically, since B is found only on the Pacific Coast of the United States and Canada, while A lives further inland and Southward, up to and including the Rocky Mountains and Mexico. Nevertheless, in the Sierra Nevada-Cascade Mountains both races occur together. Since race A has a higher temperature optimum than race B, the former tends to occupy lower elevations in mountains than the latter—a partial ecological isolation. If a choice of mates is available, race A males copulate predominantly with race A females; similarly, race B females and males cross more freely inter se than with individuals of race A. This is sexual isolation. Crossing race A and race B results in appearance in the F_1 generation of completely sterile male and fertile female hybrids. The sterility of the males is due in this case to interaction of genes contributed by both parental races, and not to dissimilarities in the gene arrangement in the two races. The offspring obtained from backcrosses of the F_1 hybrid females to the males of either pure race consists of individuals whose viability and fertility are very low. This decrease of the viability is due to a maternal effect exerted by the chromosomal complement of the hybrid mother on the cytoplasm of her eggs.

The interbreeding of either race of *Drosophila pseudoöbscura* with another closely related species, *Drosophila miranda*, is prevented by a different set of isolating mechanisms. Sexual isolation is present, that is individuals of either species mate preferably with each other and not with individuals of the other species. The viability of the F_1 hybrids between *pseudoöbscura* and *miranda* is lower than that of each parental species; this differential viability is especially pronounced in males. Female as well as male hybrids are completely sterile. The mechanism of sterility is in this case not established with certainty. It is known, however, that the gene arrangement in the chromosomes of *miranda* is very different from that in either race of *pseudoöbscura.* The differences are due predominantly to inversions which

alter the relative locations of genes within a chromosome. However, some genes which in one of these species lie in the same chromosome may in the other species be located in different chromosomes; this is an evidence of translocations of genic materials having taken place in the phylogeny. Finally, some chromosome sections present in *pseudoöbscura* can not be identified with certainty in *miranda*, and vice versa. The causation of the last class of differences is unclear; they may be due either to losses and duplications of chromosome sections in the phylogeny, or else to very profound alterations of the gene arrangement in some sections by repeated inversions and translocations.

(This article is a summary of a lecture delivered before the Marine Biological Laboratory and the Genetics Society of America on September 3, 1936).

THE NATURE OF MUTATIONS. I.

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Mutation in its broadest sense may be defined as an unexpected hereditary change. This definition includes various chromosomal abnormalities as well as what are known as gene changes. A satisfactory technique for investigating the first mentioned group of mutations, viz. chromosomal abnormalities, was available even before they themselves were known, and consequently our knowledge about these changes is good and well substantiated. On the other hand, a satisfactory technique for studying gene changes and point mutations has not as yet been worked out, although progress has been made along this line by recent discoveries of x-ray effects and of the salivary chromosomes. Consequently the work on the genic part of the mutation problem is still in its beginning stage and the evidence available at present offers a chaotic picture of this field. In such a situation there is an abundance of controversial material which offers a productive field for discussion.

Fast accumulating evidence indicates that so-called gene mutations by no means form a homogeneous group of changes. There is positive evidence to show that an effect identical to a gene change may be due to a deficiency (yellow in *Drosophila melanogaster*) or also to a duplication (bar). Evidence has been presented, still requiring confirmation, that a mere inversion of a minute section of a chromosome produces a phenotypic effect comparable to a gene change. Data are also accumulating to indicate that a great majority of lethal factors are deficiencies. All these show beyond a reasonable doubt that a group of changes called gene or point mutations consists of a variety of types for the origin of which a similar mechanism may or may not be responsible. In order to study the nature of these mutations it is essential to differentiate between the various types. At present this is possible only in Drosophila and other diptera which have large salivary chromosomes, whereas as yet no method has been discovered which could be effectively used for making such a differentiation for other organisms. Even in the case of Drosophila the method now available is laborious and requires a high degree of skill and patience. However, by analyzing salivary chromosomes it is possible to differentiate with a fair degree of accuracy between the different types of changes and thus to obtain evidence which is invaluable for the solution of the basic problems of mutation.

The most frequent hereditary changes in Drosophila are those producing a lethal effect. Because of their high frequency they have been extensively used in quantitative studies of mutation rate and therefore a large body of data has been accumulated in regard to them. Lethal changes are not only the most frequent changes occurring among random loci but they are also the most frequent changes occurring among the known loci. Similarity between the random lethals and the lethals of known loci is such that it seems justified to assume that all of them are similar in nature and that all are produced by a similar mechanism. About thirty lethals induced by x-rays and affecting visible loci have been studied cytologically. All were found to be deficiencies. This makes it very probable that at least a large proportion of lethals are of the same type, viz. that they are deficiencies.

The salivary chromosome analysis of lethals revealed one important fact, viz. that all which were examined are deficiencies for more than one salivary chromosome band, presumably for more than one locus. This fact brings us to a basic problem of the origin of these changes. There seem to be two ways by which they may be originated. One way is through a mechanical process, through the formation of a loop and subsequent pinching-off of a small piece of the chromosome, or through breakage and subsequent union of the chromosome. The other way is through a chemical process by which a chemical reaction either destroys or inactivates a block of genes through some sort of chain reaction or through a chemical change developing in the gene environment and affecting a whole block of genes. It seems very likely that both of these processes are responsible for the origin of lethals. Their origin could hardly be ex-

plained by a mechanical process only. These deficiencies are small taking from about 1/500 to 1/50 of the total length of the active X-chromosome region and consequently the loops for pinching-off such a small section must be exceedingly minute. If such small loops can be formed at all, it seems unlikely that they would be formed with a high enough frequency to account for the number of lethals obtained in the material treated by x-rays. The same holds for the breaking of chromosomes. Moreover, available evidence indicates that in certain regions of the chromosome there may be a certain degree of regularity as regards the bands involved in the deficiency. In the cut region of the X-chromosome, for example, sixteen deficiencies have been studied by Miss Hoover at our laboratory. In all but one case the deficiency is limited to a small section of three salivary chromosome bands (7B2, 3, 4 of the Bridges' 1935 map) which section is bordered on each side by a heavy capsule (7B1 and 7C1). One case only has been found so far where the deficiency involved one of these capsules and extended over a section of about nine bands. No other section of the chromosome has been as extensively studied as the cut region. The material analyzed so far suggests that, in case of deficiencies in other regions, the number of bands involved is more variable. In the cut region, therefore, two bands, which happen to be heavy capsules, seem to have a blocking effect for the spread of the deficiency. Such a condition is readily visualized if a chemical reaction is the mechanism by which deficiencies are produced but it can hardly be explained on the basis of the mechanical origin of deficiencies.

The "block effect" is evident not only among deficiencies induced by x-rays, but also among those occurring spontaneously. A number of such deficiencies has been analyzed genetically and some also cytologically, and the results indicate the existence of block effects.

A close relationship between various changes is suggested from the results of investigations with lethals and chromosomal abnormalities. Fifty-eight lethals, produced by x-rays and affecting known loci, have been investigated cytologically. In twenty-five cases it has been found that the treatment produced simultaneously a lethal and a chromosomal abnormality, either an inversion or a translocation, in the same chromosome. Of these, in twenty-three cases one of the breakage points of the chromosome coincided with the lethal change. This shows that these two changes must have been produced by the same mechanism, which means that either the process responsible for a lethal change is frequently responsible for a chromosome breakage or that the process responsible for a chromosome breakage induces frequently a lethal change as well. If lethal changes are responsible for some of the chromosomal breakages, then one would expect to find approximately the same proportion of chromosomal abnormalities among different groups of lethals irrespective of their origin. This, however, is not the case. Chromosomal abnormalities are rare among spontaneous lethals and among lethals obtained by short x-ray treatment. Their frequency increases with the dosage applied. This shows that the mechanism responsible for the origin of lethals does not induce chromosomal breakages, but that the reverse process may be true, viz. that the mechanism responsible for the production of chromosomal abnormalities frequently induces a lethal change at the point of chromosome breakage. For at least two of these lethals it has been shown cytologically that they are deficiencies. There are, therefore, at least two types of lethals which may be produced by two different though probably related mechanisms. In quantitative studies with x-rays they were not differentiated and it may be necessary to revise some of the conclusions based on these studies if it should be shown that the origin of these two types of lethals is differently affected by the treatment.

Before concluding, I wish to call attention to another important phase of the mutation problem, viz. the close relationship between immediate gene environment and changes in genes. Several cases are known where a gene is unstable only at certain stages of ontogeny. For example, reddish of *Drosophila virilis* is unstable only at a maturation division of a heterozygous female; an allel of miniature is known which is unstable in somatic cells only, and lavender of Delphinium has been shown to change with different rates at various stages of ontogeny. Apparently in order that a gene becomes unstable, it is essential for it to have a certain environment and, for the cases mentioned, such conditions are fulfilled at certain stages of ontogeny. It has been shown by Emerson for maize, and several similar cases are known in *Drosophila virilis*, that the mutability of an unstable gene is greatly increased in the presence of certain other genes. Here these genes help to produce the environment in which a particular unstable gene becomes still more unstable. Finally, it has just been discovered that the Florida wild stock of *Drosophila melanogaster* possesses a factor which increases the rate of mutability in this stock almost ten times. This factor is located in the second chromosome and indications are that it is active only early in the embryo. These mutability stimulating factors cannot have a direct action on the genes they affect but must act through the environment. This suggests that genes and their immediate environment form an intimately interacting system and also that the stability of genes is affected by their environment.

In concluding this introduction I shall raise four questions which may serve to start the discussion.

(1) What is the mechanism by which changes are induced by x-rays? Are they produced by a direct hit of an electron or are they produced indirectly through the environment of the gene?

(2) With the first question the second one can be combined. How are chromosomal changes produced? Are they produced through what may be called an illegitimate crossing-over process or through chromosomal breaks and the subsequent fusion of the broken parts?

(3) What is the possible mechanism of simultaneous changes producing both a lethal effect and a chromosomal abnormality?

(4) What is the nature of block changes and what is the mechanism of their origin?

(This article is an introduction to a round table conference by the Genetics Society of America at the Marine Biological Laboratory on September 5, 1936).

THE NATURE OF MUTATIONS. II.

Prof. L. J. Stadler

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The conference this morning, although it bears a different label, is essentially nothing more than a continuation of yesterday's discussion ("Progress in Cytogenetics"). There was a time, and not so very long ago, when those who were interested in mutation could sit smugly by while chromosomes disrupted and cytologists wrangled, secure in the knowledge that the really fundamental process, the mutation of the gene, had nothing to do with these incidental distractions. The gene was an independent particle, no doubt a giant molecule, and true mutation was a change in the chemical structure of this molecule. Other hereditary variations were due to "chromosome aberration," but these had no connection, or at most only an incidental connection, with the transformation of the gene.

X-rays produced alteration of both kinds, but it was elaborately proved that the gene mutations produced by this treatment were due to changes fundamentally different in kind from those involved in the chromosomal derangements, and the total of gene mutations, including recessives and dominants, lethals and visibles, was taken as a measure of the power of the radiation to change the internal structure of the gene.

These gene mutations were extremely rare under natural conditions, as far as most genes were concerned, although there were some heterodox genes in which mutation was not so rare. This did concern us seriously; the explanation was close at hand, they were simply highly mutable genes. The reason that they changed so often was simply that they mutated frequently. And indeed this sort of explanation is almost all that can be looked for so long as we maintain the premise that all gene mutation is due to change in the gene-molecule. The chemical nature of these assumed transformations of the hypothetical molecules is as yet hopelessly beyond the reach of experimental analysis.

I take it that we are generally agreed that the classical model of gene mutation must be modified in certain respects. There is no question that the chromosome is linearly differentiated. It is convenient to retain the name of gene for the hypothetical unit of this differentiation, but it is no longer safe to assume that every mendelizing variation is due to a change in the internal structure of one of these units, or even to assume that such changes are generally responsible for mendelizing variations and may be taken for granted whenever some grosser modification cannot be demonstrated. The accumulating mass of evidence for extra-genic alterations of various kinds, producing genetic effects which meet all the tests of gene mutation, forces us to consider the possibility that some of our basic notions of gene mutation may be in error. If the ultimate unit of differentiation is to be called the gene, the point mutations at a given locus may depend on changes (both intra-genic and extra-genic) of several genes. If the material basis of each mendelizing variation is to be called the gene, it may be necessary to postulate smaller units within the genes so defined.

These extra-genic alterations are of 3 general types, losses of genes, additions of genes, and changes in the spatial relations of genes. The shift in emphasis to the extra-genic types of mutation is a hopeful development, for these, unlike the intra-genic mutations, are subject to analysis by methods now available. Perhaps the analysis of these mutations (or pseudo-mutations) may lead ultimately to the development of methods for the analysis of the chemical changes which must underlie the qualitative differentiation of the chromosome.

It goes without saying that we are not yet in a position to set up an acceptable model of mutation which will provide for all sorts of processes capable of producing variations of the type of which we speak as gene mutations. The purpose of this conference, I presume, is to discuss the sorts of evidence which will be needed to enable us to construct such a model.

I shall speak briefly of three types of evidence which may be helpful in this task. These are concerned with (1) the mechanism of gene rearrangement, or translocation in the broadest sense, (2) methods for the study of minute losses, additions and rearrangements of genes, and (3) attempts to separate the complex of mutations and

OFFICERS OF THE GENETICS SOCIETY OF AMERICA AT WOODS HOLE
Left to Right: Dr. D. F. Jones; Dr. L. J. Stadler; Dr. R. A. Emerson; Dr. M. Demerec.

chromosomal aberrations by the use of different physical agents to induce germinal alterations.

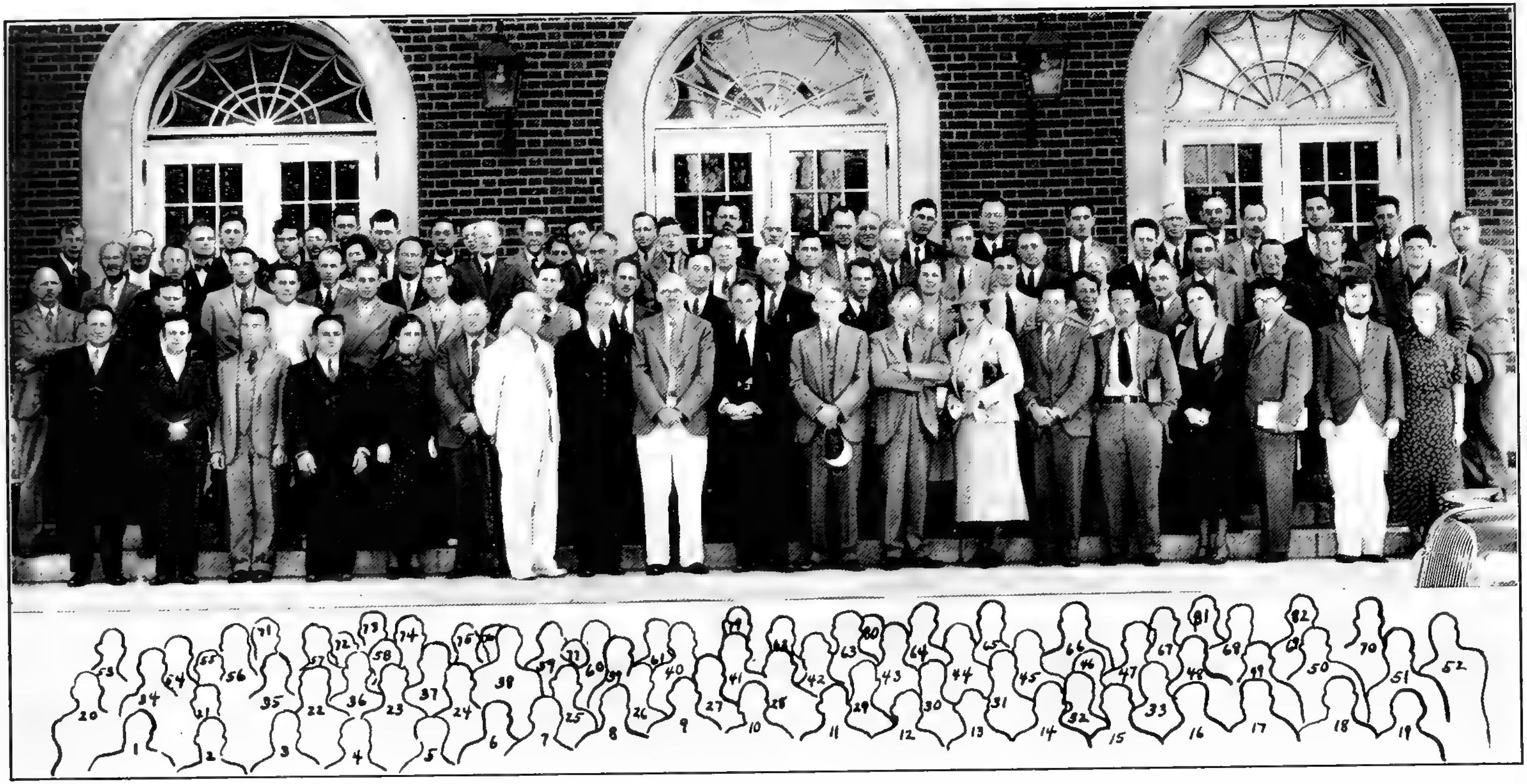
The mechanism of gene rearrangement was discussed in yesterday's conference. This problem is of interest in connection with mutation because of the association of mutations and chromosomal derangements in progeny of x-rayed material. Mutations occur frequently at points of chromosome breakage, although there are many mutations which are not associated with detectable chromosome derangements.

The hypothesis generally accepted is a modification of Serebrovsky's and Dubinin's hypothesis suggested by Muller. This hypothesis accounts for the chromosomal derangements by a sort of illegitimate crossing over induced by the treatment at points of contact between two chromosomes or between parts of the same chromosome. This yields reciprocal translocations, internal inversions and internal deficiencies, derangements which are frequently found among chromosomes altered by irradiation.

The results of irradiation in maize suggested a somewhat different mechanism. According to this scheme the effect of the radiation is merely to cause breaks in the chromosomes and the fragments tend to reattach later at points of breakage. If reattachment occurs, translocations, inversions and deficiencies result, similar to those expected on the basis of the other hypothesis. If the detached fragment fails to become reattached before it is lost from the nucleus, deficiencies result, many of them being long terminal deficiencies.

This hypothesis appeared to fit the maize results more satisfactorily than the other, not merely because it provided for the occurrence of terminal deficiencies (which seem to be very common in maize), but also because it provided a possible mechanism for the phenomenon of "recovery," which apparently results from reattachment which may be delayed through several cell generations. Under this hypothesis we would expect that the type of "gene mutation" which occurs at points of breakage in translocations might occur also at points showing no indication of chromosome breakage, since in many cases a fragment would reattach at the point of original breakage.

A crucial test of these two hypotheses is not easily devised, since the derangements expected are so nearly identical. Certain types of alteration are much less frequently expected under one than under the other, since complex inter-chromosomal or intra-chromosomal translocations would require a very involved pattern of inter-crossing strands under the crossover hypothesis but would be expected not infrequently by chance recombination of detached fragments. This point, as related to intra-chromosomal translocations, has been discussed by Glass. The clearest contrast between the results of the two suggested mechanisms is in the occurrence of terminal deficiencies. We have not relied too heavily on these in maize



BIOLOGISTS ATTENDING THE MEETINGS OF THE GENETICS SOCIETY OF AMERICA AT WOODS HOLE ON THE STEPS OF THE MARINE BIOLOGICAL LABORATORY

(1) L. C. Strong. (2) W. Murray. (3) I. Koster. (5) T. Wood. (6) D. F. Jones. (7) C. E. McClung. (8) C. B. Bridges. (9) L. R. Dico. (10) Th. Dobzhansky. (11) A. M. Banta. (12) H. Walter. (13) Mrs. R. Harris. (14) I. Dordick. (15) N. Kaliss. (16) M. E. Hoover. (17) B. Slizynski. (18) R. H. MacKnight. (19) K. Brehme. (20) J. W. Mavor. (25) H. B. Glass. (26) Beadle. (27) L. J. Stadler. (28) R. A. Emerson. (29) S. Reed. (32) S. Hughes-Schrader. (33) Hans Bauer. (34) H. H. Plough. (37) D. Raffel. (38) E. M. East. (39) C. B. Davenport. (40) F. Hanson. (41) H. Feldman. (42) R. Singleton. (43) L. B. Clark. (44) F. Schrader. (45) K. Sax. (46) Mrs. K. Sax. (47) J. Eigsti. (48) Smith. (49) C. L. Parmenter. (51) H. Albaum. (53) B. R. Nebel. (54) C. W. Metz. (56) M. Demerec. (57) A. Avery. (58) E. Carothers. (59) T. H. Morgan. (60) A. Weinstein. (63) J. H. Bodine. (64) Sawin. (66) A. G. Steinberg. (67) F. Hays. (68) Margolis. (69) G. Child. (70) D. E. Lancefield. (71) A. Marshak. (72) A. Boyden. (73) C. W. Robertson. (74) P. S. Henshaw. (77) M. J. Hogue. (79) C. C. Little. (80) S. O. Mast. (81) H. Goodale.

because in individual instances there is always the possibility that the apparently terminal deficiency is in fact non-terminal with one break very near the end of the chromosome. This possibility makes almost any individual instance questionable, although the frequency of apparently terminal deficiencies is so high that they cannot be accounted for on this basis without a special hypothesis to account for an extremely high frequency of breaks near the end of the chromosome. In Drosophila not many terminal deficiencies have been found, but this may be due to factors affecting the viability of long deficiencies or deficiencies of the end region of the X-chromosome.

The chief reason for the general adoption of the illegitimate crossover hypothesis seems to be the relation of the frequency of chromosomal derangements to dosage. It is assumed that the frequency should increase with the square of the dosage if rearrangements require the coincidental occurrence of two breaks. Oliver found that the frequency of chromosomal derangements increased with dosage but not much more than in direct proportion, and Muller concluded that this is irreconcilable with the hypothesis of translocation by reattachment of fragments.

This argument is, I believe, wholly invalid, for it is dependent on the assumption that the number of breaks is relatively small. We have no way of estimating the number of breaks induced by the radiation, since there is no way of telling how many fragments are reattached in their original position. The expected frequency of translocation on the assumption of free interchange of position among fragments may be calculated for any assumed frequency of breaks. With 40 breaks per hundred cells we would expect 6 cells to have 2 or more breaks; with 80 breaks per hundred cells 19 should have 2 or more breaks; with 160 breaks per hundred cells only 48 cells should have 2 or more breaks. Thus doubling the number of breaks does not quadruple the number of opportunities for translocation; it approximates this only when the number of breaks is low, and it falls short of this relation more and more as the number of breaks increases. If the number of breaks is large enough, the expected increase in translocation may be even less than in direct arithmetic proportion. The dosage relation therefore does not help us to decide between the two hypothetical mechanisms of translocation.

The two hypotheses mentioned are not the only possible mechanisms of induced gene rearrangement, and certain types of derangement observed are not satisfactorily accounted for by either. It is not improbable that other phenomena are involved in the occurrence of such alterations as for example, the deficiency and translocation of minute chromosome segments. However, as far as these two hypotheses are concerned, I think we must consider the question still an open one, and the evidence now available is, I believe, more favorable to the hypothesis of fragmentation and subsequent reattachment than to that of illegitimate crossing over.

I should like next to take up briefly the efforts to produce for experimental study minute extragenic changes.

(*Slide*—showing two chromosomes exhibiting non-homologous pairing. In such non-homologously paired chromosomes, if crossing-over may occur in the regions of non-homologous pairing one then has a chance for the production of minute extragenic changes; for example, a crossover in this region may result in the production of a new deficiency in one of the chromosomes while the other would have the original deficiency plus a duplication. Various modifications of this are obtainable depending upon the locus of the crossover. Some results have been obtained which can only be interpreted upon the basis of non-homologous crossing-over.)

The third point which I want to bring up is the results of studies with ultra-violet radiation in collaboration with Dr. G. F. Sprague. The ultraviolet studies are interesting chiefly because of the possibility of detecting different genetic effects of different wave lengths. The corn plant is particularly favorable material for these studies since there are a number of endosperm characters which can be used to give an indication of the critical regions of the spectrum which are effective in inducing deficiency.

Using unfiltered ultra-violet light, a great increase in deficiencies is obtained, though the number is less than that produced by large x-ray doses. Several differences between the results obtained with x-rays and those produced by unfiltered ultra-violet may be noted. One important difference is the frequent occurrence of fractionals with ultra-violet. Also the frequency of mutation at different loci differs with x-ray and ultra-violet treatment.

(*Slide*—on the genetic effects of different wavelengths of filtered ultra-violet. Using 3 mercuric chloride filters. Results: wave-length band 3130 and longer were found to be genetically ineffective; 2967 and shorter were effective; 3022 effective but reduced as compared to 2967. Ultra-violet produced by a mercury discharge tube, wavelength line 2537, was found to be ten to fifteen times more effective genetically in power to give deficiencies.)

(*Slide*—comparison of ultra-violet with x-rays. Ultra-violet produces more fractionals than whole chromosome losses. X-ray produces more whole chromosome losses than fractionals.)

(This article is an introduction to a round table conference of the Genetics Society of America at the Marine Biological Laboratory on September 5).

RESEARCH FACILITIES OF THE U. S. BUREAU OF FISHERIES

(Continued from page 217)

methods in vogue at the time].

To provide adequate facilities for these studies, Baird chose Woods Hole as the location for the first permanent marine biological station in America and secured vessels for marine research. The schooner *Grampus* was the first, soon followed by the steamer *Fish-hawk* and later by the steamer *Albatross* which, it is said, has contributed more to marine investigations during its many years of service in both the Atlantic and the Pacific than any other American vessel. Stimulated by Baird's activity Louis Agassiz established a summer laboratory on Penikese Island which was later removed to Woods Hole and thus fathered the present Marine Biological Laboratory, which with its neighboring laboratory, The Woods Hole Oceanographic Institution, has established Woods Hole as the center of marine biological research in America.

FISHERY RESEARCH AT COLUMBIA, MISSOURI
A corner of one of the eight laboratories provided by the University of Missouri for the study of the effects of stream pollution on fishes.

The U. S. Bureau of Fisheries has continued the work initiated by Baird and fishery research remains one of its major activities. The research program of the Bureau of Fisheries (see Walford, The Collecting Net, Vol. XI, No. 8) seeks the application of knowledge in the fields of marine and fresh water ecology, oceanography, fishery biology and aquiculture, to the problems of the commercial fisheries and their maintainence on the basis of sustained yield, to the cultivation of water crops in lakes and streams and to the cultivation of shellfish. The organization of the Division of Scientific Inquiry reflects these major objectives in four sections engaged in commercial fishery investigations on a geographic basis, in two sections concerned with aquiculture, the section on the fresh water sport fisheries and in one engaged in the study of shellfish culture. These sections under the direction of competent and experienced biologists are staffed by some 45 permanent investigators and by varying numbers of temporary biologists and assistants housed in field laboratories throughout the country. The following is a brief account of the organization of research facilities in the various sections.

Washington Laboratories

In addition to the administrative and clerical staffs of the Division, laboratories are provided in the Commerce Department building for Dr. H. S. Davis, head of the section of aquicultural investigations, and Dr. Paul S. Galtsoff, head of the section of shellfish investigations with their assistants. These laboratories are equipped for physiological investigations, chemical analyses and

UNITED STATES QUARTER-BOAT 348 ON THE MISSISSIPPI RIVER

Provides a floating laboratory for the study of stream pollution and propagation of fresh water mussels.

HATCHERY AND LABORATORY BUILDING AT THE EXPERIMENTAL FISH HATCHERY NEAR CHARLESTOWN, WEST VIRGINIA

Extensive ponds and raceways are provided for experimental studies on the culture of trout and bass.

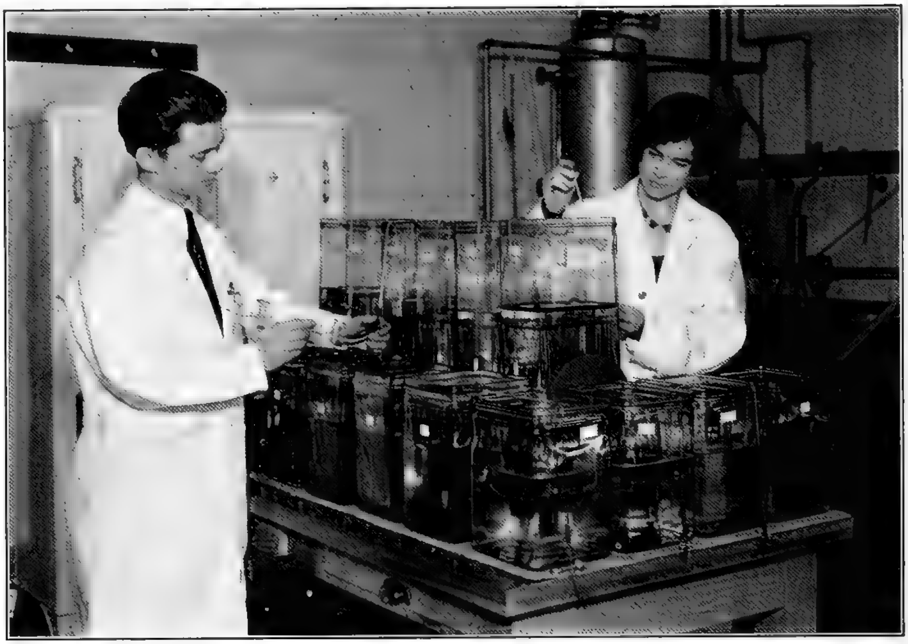
pathological researches. Another laboratory and an extensive collection of fishes is also maintained where Dr. S. F. Hildebrand and Isaac Ginsberg are conducting studies in systematic ichthyology. A central library of more than 50,000 volumes and reprints is maintained and circulated among the field laboratories.

North Atlantic Fishery Investigations

In offices and laboratories provided by Harvard University, O. E. Sette, William C. Herrington, and Robert A. Nesbit are conducting investigations of the mackerel fishery, the haddock fishery and the shore fisheries of the North and Middle Atlantic sections, respectively, together with a staff of field observers, statistical clerks and assistants. Until 1933 the steamer *Albatross II* was also utilized in the study of fishery biology and of the fishing grounds of the North Atlantic area. Major objectives of these studies are to determine the condition and trend of these important fisheries and the natural factors that effect their yield from year to year including the three major variables, birth rate, death rate and migration. In recent years cooperation with the Woods Hole Oceanographic Institution in these studies has been afforded by detailing the Institution's vessel *Atlantis* to studies of Georges Bank and adjacent waters.

South Atlantic Fishery Investigations

Headquarters are maintained at New Orleans, Louisiana, and Brunswick, Georgia, with a field station at Aransas Pass, Texas, for similar studies on the great shrimp fishery of the south Atlantic and Gulf coast. A 65 and a 45 foot motor launch are utilized in these studies and during the coming year the Bureau's 85 foot motor ship *Pelican,* which is now being outfitted for oceanographic research and experimental trawling, will be detailed to the Gulf coast for this work. Milton J. Lindner is in charge, and Dr. Lionel A. Walford and John C. Pearson are assistants.



TEMPORARY FIELD LABORATORY AT YORKTOWN

For the study of the effects of pulp mill pollution on oysters.

Great Lakes Fishery Investigations

Laboratories are provided by the University of Michigan as headquarters for the Great Lakes fishery investigations. Dr. John Van Oosten, Dr. Ralph Hile, and Dr. H. J. Deason are there engaged in studies on the whitefish and lake trout fisheries, biostatistical analyses of the net fisheries in Michigan waters of the Great Lakes and in studies of the fisheries for the pike-perches, respectively. During the recent years the steamer

TEMPORARY FIELD LABORATORY AT MILFORD
For the study of shellfish culture and the control of oyster pests.

ONE OF THE TIDE-FILLED TANKS AT MILFORD
Used in shellfish culture experiments.

Shearwater was engaged in extensive cooperative surveys of Lake Erie, and the motor ship *Fulmar* was provided for extensive limnological studies in Lake Michigan and experimental fishing to determine the effect of various types of gear upon the fish stock.

Pacific Coast Investigations

The laboratory owned by the Bureau of Fisheries adjacent to the University of Washington at Seattle with laboratory and office facilities provides for a staff of investigators engaged in the study of the problems of the fisheries of the Pacific coast states and Alaska. In Oregon and Washington chief attention is given to the development and protection of runs of salmon in the Columbia River, in Puget Sound and in the Fraser River of British Columbia. In Alaska chief attention is given to studies of the red salmon, the pink salmon and the herring. On the basis of these studies the Bureau regulates and maintains the valuable fisheries of Alaska. This station is directed by Dr. F. A. Davidson, assisted by Dr. G. A. Rounsefell, J. A. Craig, H. B. Holmes, J. T. Barnaby and others. Various ships of the Bureau's Alaska patrol fleet are used in investigations as occasion demands.

Investigations of Fresh Water Fisheries

A study of the effect of stream pollution on fresh water fishes is conducted by Dr. M. M. Ellis, and assistants in laboratories provided by the University of Missouri at Columbia, Missouri. An 85 foot quarterboat with two launches provide laboratory facilities on the Mississippi River and its tributaries, and two auto trucks are equipped with special laboratory equipment for field studies.

Aquicultural investigations under the direction of Dr. H. S. Davis are concerned primarily with improvements in hatchery technique, the nutrition of game fishes in hatcheries, the combating of diseases, and the rational stocking of lakes and streams. In addition to the pathological laboratory maintained in Washington, studies of fish diseases are conducted by Dr. F. F. Fish at the Seattle laboratory and two experimental fish hatcheries are maintained for study of hatchery and stocking problems, one at Pittsford, Vermont, under the direction of R. F. Lord, and one at Charlestown, West Virginia, under E. W. Surber, assisted by Dr. J. S. Gutsell. A field laboratory for trout investigations in California is provided by Stanford University under the direction of Dr. Paul R. Needham, and cooperative studies in fish nutrition under Dr. C. M. McCay of Cornell University are conducted in the Laboratory of Animal Nutrition of the State Agricultural College and at the Bureau's experimental hatchery at Cortland, New York.

Shellfish Investigations

Under the direction of Dr. Galtsoff with headquarters in the Washington Laboratory studies are conducted at a number of field stations concerned with the problem of shellfish culture, particularly the cultivation of natural and planted beds of oysters, the effects on oysters of industrial pollution, and the control of shellfish pests. One of these laboratories is located at Milford, Connecticut, under the direction of Dr. V. L. Loosanoff, one at Olympia, Washington for the study of the culture of the commercial Pacific species of oysters under the direction of Dr. A. E. Hopkins, one at Apalachicola, Florida, under R. O. Smith, and one at Yorktown, Virginia, under Dr. W. A. Chipman. The Woods Hole laboratory in recent years, owing to lack of funds, has been closed except for researches on the physiology of oysters conducted by Doctor Galtsoff and assistants during the summer months. The Beaufort, North Carolina, Fishery Biological Laboratory also has been engaged in various researches during many years. At the present time under the direction of Dr. H. F. Prytherch these facilities are utilized chiefly in oyster investigation in the south Atlantic area. Each of these stations is fully equipped for physiological and biological studies of oysters, oyster pests and oyster cultural problems.

In former years facilities of the laboratories at Woods Hole, Mass., and Beaufort, North Carolina, have been offered to private investigators qualified for undertaking productive studies in the field of marine biology. For the past three years, as mentioned above, the Woods Hole laboratory has been closed. Accommodation for study is provided throughout the year to independent investigators, however, at the Beaufort, North Carolina, laboratory, where the usual equipment of a marine laboratory is available including running sea water, the usual laboratory glass-ware and reagents, and excellent collecting facilities including launches and rowboats. Laboratory and dormitory quarters are provided free of charge to investigators who wish to pursue their own lines of investigation, selection being based upon the competence of the applicants and the relation their problems bear to the major program of the Bureau of Fisheries.

Facilities are also provided where they are available at other stations of the Bureau of Fisheries for private investigators but general researches in marine biology are best conducted at Beaufort and Woods Hole.

A DECADE OF BIOLOGY AT HARVARD UNIVERSITY

DR. ALDEN B. DAWSON
Professor of Zoology, Harvard University

During the past ten years there has been a steady increase in the scope and diversification of the activities of the division of biology at Harvard University. The development of physiological botany and the further extension of the zoological sciences into experimental fields characterize this period. The nature of inheritance, the tropistic responses of organisms to their environment and other types of reactions have been increasingly emphasized. Static morphology has been further supplemented by the experimental study of form. Descriptive embryology has been vitalized by the experimental approach and the modern and important field of general physiology has been developed. In these newer experimental fields the methods of physics and chemistry, supplemented by mathematics, have become an integral part of biological methodology. More recently the significance of hormones in the reproduction, development and behavior of organisms has also received considerable attention.

However, in the midst of all these newer biological activities the older, classical disciplines have not been neglected. Problems of taxonomy, phylogeny, geographic distribution, life history and the like have been under continuous investigation. Nor have the more practical aspects of biology failed to receive their merited attention. Many members of the division have been acutely aware of the increasing opportunities which a knowledge of their science offers for the betterment of human welfare. This interest is expressed in such fields of study as economic botany, economic entomology, forestry and forest pathology, plant and animal genetics, plant and animal nutrition, oceanography and plant and animal parasitism.

Ten years ago the three main laboratories for instruction in biology were located in the University Museum. The departments of botany and physiology were accommodated in the Botanical Museum while the department of zoology occupied space in the Museum of Comparative Zoology. Besides this nucleus there were several other separately endowed units of the University which were affiliated with the division of biology and provided facilities for instruction and investigation. These included the two museums just mentioned, which form a part of the University Museum and seven other institutions situated at varying distances from the central laboratories in Cambridge: the Botanic Garden, the Gray Herbarium, the Bussey Institution, the Arnold Arboretum, the Harvard Forest, the Farlow Reference Library and Herbarium and the Atkins Institution of the Arnold Arboretum (Cuba).

With a rapid growth of biology and the introduction of experimental methods the quarters and equipment provided in the Museum rapidly became inadequate and new laboratory space was badly needed. Happily, in 1931, through the generosity of the Rockefeller Foundation and the Harvard Corporation the new Biological Laboratories were erected and excellent space and equipment for instruction and investigation became available.

With the relief from overcrowding it became obvious that there was an opportunity for reorganization to provide for a greater co-ordination of effort. Accordingly an endeavor was made to include in the central unit as many workers as possible from the outlying stations and much has been accomplished in the past few years to unify the work of the several independent groups and to develop further co-operation in research and instruction. As an additional step in this direction the departments of botany, physiology and zoology were consolidated in 1934 into one department within the division of biology. At the same time the curriculum was revised with a view of facilitating the training of students from a broader biological viewpoint and co-ordinating the resources of the laboratories.

It is obviously impossible in the space of this review to mention the many persons who have been associated with the division of biology for the past decade or to give a particularized account of their varied biological interests. Many of the staff giving instruction ten years ago are still actively working at Harvard. There have been relatively few resignations and the inevitable losses due to retirement and death have not been great in number. In several instances the losses due to retirement have been greatly mitigated by the continued residence and activity of the professors emeriti. Certain new appointments have filled in many of the gaps while other appointments representing newer fields of biological interest have greatly increased the total number of persons giving instruction and directing research.

The greatest addition to the material facilities of the division of biology within the past ten years is the new laboratory building in which thirty-five members of the teaching staff and some ninety graduate students are now accommodated. The various units within the building include not only working space assigned to members of the staff and their students but also many common units which serve the needs of all or of special groups. Among these are stockrooms, student and staff

shops for both metal- and wood-working, and a large fully equipped photographic suite. Special darkrooms for experimentation and photography, cold rooms providing a wide range of low temperatures, constant temperature rooms for higher temperatures and constant-temperature constant-humidity rooms represent some of the more specialized services. In addition a large series of air-conditioned animal rooms provide for the maintenance of colonies of mammals and birds and the greenhouses on the roof supply both terrestrial and aquatic material for class and experimental needs.

These are supplemented by a number of aquarium and terrarium rooms for aquatic and semi-aquatic plants and animals. Sterilizing rooms and culture rooms are also conveniently located. Other units designed for more special uses include sound-proof rooms, a physical exercise room and a room with special foundation piers, free from vibrations, for making delicate measurements.

To close with a tabulation of the material resources for scientific work may seem to strike a discordant note. Great genius may survive in an attic but ordinary mortals may not disdain the aid of an adequately equipped laboratory.

THE BIOLOGICAL SCIENCES AT PRINCETON UNIVERSITY

Dr. E. G. Butler
Associate Professor of Biology, Princeton University

All work in the biological sciences at Princeton University is aggregated in the department of biology. In this department courses are presented and facilities for research provided in the fundamental fields of biology. The main laboratories of the department are located in Guyot Hall. In addition, a departmental vivarium adjacent to Guyot Hall, provides facilities for the care of experimental animals and work rooms and operating rooms for student instruction. In the vivarium also, are aquaria for the maintenance of aquatic animals. Two departmental greenhouses, one of which is connected with the vivarium, are equipped for work in botany, and near the greenhouses a large field has been set apart and especially prepared for work in plant genetics.

Within the last ten years several changes have taken place, which have resulted in considerable expansion of departmental activities. For the most part, these changes have been concerned both with a broadening of the scope of departmental research and with an intensification of activity in several fields long represented at Princeton. In this connection it is important to note that an extremely active program of investigation and advanced instruction in endocrinology has been instituted. At the same time the work in general physiology and biochemistry has been greatly extended. More intensive research over a broader field than heretofore has been introduced in the general field of experimental biology, including work and instruction in experimental cytology, embryology and morphology. In addition, experimental research in genetics has been more closely correlated with cytological work. It is important to point out, however, that older biological fields, such as general invertebrate and vertebrate morphology, continue as active fields of endeavor at Princeton.

The entire biological program at Princeton has been especially facilitated by the establishment of the Scientific Research Fund of the University. In 1928 an endowment of three million dollars, one-third of which was contributed by the General Education Board, was obtained for the promotion of research in mathematics, physics, astronomy, chemistry, and biology. The income of this fund is allocated to the five departments concerned under the general supervision of a Scientific Research Committee. This income supplements appropriations for research from the general funds of the University. In a large measure it has been through the resources offered by this new fund, that the department of biology has been able to inaugurate extensive programs of research in several fields hitherto unrepresented at Princeton. Moreover, together with the other scientific departments, the department of biology has sponsored during the last few years cooperative programs of research in fields which overlap the boundaries of two or more departments, especially in the fields of biochemistry and biophysics.

Correlated with the general expansion and increase in intensity of the research program there has been, necessarily, an increase in the size of the biological staff. This has involved not only an increase in teaching members of the staff, but especially an increase in advanced investigators, research associates and research assistants. In connection with the matter of staff changes, it is particularly gratifying to report that Professors E. G. Conklin and C. F. W. McClure, although they have reached the statutory retiring age and have been relieved of teaching responsibilities, remain, nevertheless, active and important members of the departmental group.

In the field of graduate instruction in biology provision is made both for beginning and for advanced graduate students, including post-doctoral research students. To aid the beginning graduate student in acquiring a broad biological background a group of graduate courses are offered, which cover, so far as possible, the main funda-

mental fields of biology. Other more advanced courses afford opportunity for instruction and beginning research in certain specialized fields, especially, general and mammalian physiology; endocrinology; biochemistry; experimental cytology; experimental embryology and morphology; and genetics. Particular emphasis at Princeton has long been placed upon individual instruction, both for graduate and for undergraduate students. For many years, therefore, the enrolment of graduate students, as well as of undergraduates, has been restricted. In association with the restriction of enrolment in the Graduate School as a whole, the enrolment of graduate students in each department is limited to a definite maximum. The quota for the department of biology is fifteen students. Because of the policy of limitation it is always possible to provide graduate instruction in small groups, and, in all cases, to arrange a graduate program to suit the needs of each individual student. Moreover, in a relatively small graduate group it is possible, especially in advanced graduate years, to lay particular emphasis upon the research program of each student, rather than upon general course work.

The department has been especially fortunate in the intimate association which has grown up between it and neighboring biological laboratories. The division of animal pathology of the Rockefeller Institute for Medical Research when first established at Princeton utilized laboratories made available by the University in Guyot Hall. The present extensive and well equipped laboratories of the Institute, both for animal and for plant pathology, are now situated about two miles from Guyot Hall. Seminars at the Institute are open to members of the staff and advanced students in the department of biology, and likewise workers at the Institute regularly attend the seminars of the department. More recently the establishment of the Morris Biological Farm of the Wistar Institute near Bristol, Pennsylvania, about fifteen miles from Princeton, has added another biological laboratory with which the department has formed an intimate and important relationship.

BIOLOGY AT CLARK UNIVERSITY

Professor Hudson Hoagland, *Chairman of the Department of Biology, Clark University*

The Clark University biology department offers courses of instruction in botany, zoology, comparative and general physiology. The physiological courses require fairly extensive prerequisites in the physical and biological sciences and this fortunately has tended to break down departmental boundaries and broaden the significance of the undergraduate science instruction. A number of undergraduates majoring in biology go on to graduate work in physiology or enter medical schools. The department offers the M. A. degree in biology and the Ph. D. in general physiology. The graduate work has been facilitated by certain Clark scholarships and fellowships which are annually available. Relations with the psychology department have been especially cordial. Graduate students in psychology during the past five years have done their minors in general physiology, and several of them on receiving their doctorates in psychology have obtained research positions in physiological laboratories.

The research program centers around the rather diverse interests of members of the staff. In the field of animal biology these interests are, however, sufficiently homogeneous to give the program a certain coherence. The botanical research of the department consists of an active program under the direction of Dr. David Potter concerning problems in taxonomy and plant distribution, especially of plants from the northeastern portion of Canada, one study being concerned with the Hudson Bay region and another with the flora of Newfoundland Labrador. Potter and his students have made extensive collections in these regions and have been able to suggest answers to certain interesting questions concerning the geological history of the land masses from their botanical data.

Charles M. Pomerat assisted by Meyer Zarrow is engaged in studies of the respiration of small intact organisms by means of the Warburg technique. They have obtained precise temperature characteristics for respiration of newts with a view to observing shifts in the metabolic temperature characteristic as a result of endocrine operations and endocrine therapy. Assuming that the temperature characteristic serves as a pacemaker index regulating cellular (predominantly muscle) respiration, its modifications by way of shifts of endocrine balance are highly suggestive. In addition, Pomerat is continuing his work on aspects of homogamy. During the present academic year he is on leave of absence and his vacancy has been filled by Dr. John T. Fuller who is giving courses in zoology.

During the past five years much of the research in the department has centered about certain problems of nerve physiology. This work has been greatly expedited by grants to Hudson Hoagland from the Rockefeller Foundation and by smaller apparatus grants from the National Research Council, the American Academy of Arts and Sciences, and the Bache Fund of the National Academy of Sciences.

Dr. C. Ladd Prosser is continuing his studies

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The Collecting Net

A weekly publication devoted to the scientific work at marine biological laboratories

Editorial: Ware Cattell, Elizabeth Thornton, Ursula Reinhardt and Annaleida Snyder Cattell.

Business: Arthur C. Stirling, Amy Gamble, Boris Gorokhoff and Marjorie Higgins.

Entered as second-class matter July 11, 1935, at the U. S. Post Office at Woods Hole, Massachusetts, under the Act of March 3, 1879.

THE HUNDREDTH ISSUE

This is the 100th issue of THE COLLECTING NET; when the first number appeared in 1926 little did one expect that ninety-nine others would come after it. Beginning as a local laboratory news sheet eleven years ago it has developed into a recognized journal with characteristics peculiarly its own. Each year its circle of readers widens, indicating that it fulfills the need for an informal journal devoted to the work and the workers at biological laboratories.

We have been fortunate in our contributors to this anniversary issue of THE COLLECTING NET; to them and to the advertisers in it we express our appreciation for their support.

EVANS' RECENT ADVANCES IN PHYSIOLOGY, **revised edition by W. H. Newton. 500 pp. Blakiston. 1936. $5.00.**

For many years "Recent Advances in Physiology" has given useful surveys of the physiological topics which are being subjected to the most active investigation. We have become accustomed to using "Recent Advances" for the preparation of our lectures and we usually refer to "Recent Advances" in order that the lectures when given may be understandable.

The idea which is behind the book is not modified by Dr. Newton, who has prepared this edition. Four chapter headings of the previous edition are retained. These chapters deal with the coronary circulation, the carotid sinus, the carriage of carbon dioxide by the blood and conduction and excitation in nerve. Each chapter has been revised to include the most recent work and the summary of the newer research is surprisingly complete for such a concise form of expression.

Among the new chapters it seemed to me that the one dealing with the spinal reflex was the best. It gives a clear view of the simple scheme of the spinal reflex, of the methods by which it can be studied and of the critical considerations which affect the data and the conclusions.

There is an excellent review of the methods for studying the action of the enzyme carbonic anhydrase. I feel that such a detailed discussion is hardly necessary, for the extent of the physiological rôle of the enzyme can only be suspected at present. It is probably well to discuss the methods of careful study, but it is the implications of the importance of viewing physiological reactions for kenetic processes rather than for equilibrium states which is the really valuable contribution of the work of Roughton and his associates.

In regard to all of the subjects in the book, it seems unfortunate that it is usually considered necessary to describe so much physiological detail without a clear attempt to designate the physiological organization of the details. In the chapter on the metabolism of cardiac muscle many results of chemical analyses are summarized, but there seems to be no attempt to define the physiological problem of how the chemical energy is applied to the contractile activity which is not chemical. Again, in the chapter on the carotid sinus it is apparent that sensory impulses from pressure, oxygen lack and carbon dioxide variously influence cardiac, vasomotor and respiratory activity. Those facts are important and it is desirable that the fine experiment on the functions of the carotid sinus should be made familiar. But it is possible that the importance of the carotid sinus is at present over-rated, just as it was entirely missed during so many years. The possibility of other similar sensory areas should be regarded and it should be considered that there are many other sensory nerves which affect the circulation and respiration. I believe that our present information is adequate to permit an estimate of the function of the carotid sinus in relation to the whole system of respiratory control and that to view the details in such a light would allow the elimination of some details and would suggest the course along which further advances are likely to proceed. The purpose of such a book might well include careful speculation on future advances, for it is written for progressive students.

LAURENCE IRVING

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ITEMS OF INTEREST

PROFESSOR E. B. WILSON of Woods Hole and Columbia University was awarded the Carty medal and prize by the National Academy of Sciences at the Chicago meeting. Professor Wilson was unable to attend the Chicago meeting and the medal and prize were presented to him at a luncheon at the University Club in New York City on December 5th. Those present at the luncheon were: Drs. Frank B. Jewett, Ross G. Harrison, Simon Flexner, Gary N. Calkins, W. K. Gregory, J. McKeen Cattell and C R. Stockard. Professor Harrison gave a summary of the acceptance speech which he had given in Chicago where he received the medal for Professor Wilson.

At the time of the meetings of the American Zoological Society in Atlantic City, Dr. S. O. Mast, professor of zoology at the Johns Hopkins University, was the guest of honor at a dinner given to him by his students in commemoration of his twenty-five years of service to the university. The group was joined by colleagues and friends, as well as by Mrs. Mast and their daughters, Louise and Elizabeth. (Margaret, their third daughter, is studying economics at the University of Munich). His portrait in oils, the work of Hans Schlereth, was unveiled, and Dr. Mast was presented with bound volumes of testimonial letters and of his 130 reprints. The head of Dr. Mast's department, Professor H. S. Jennings, acted as toastmaster and toasts were given by Drs. L. M. Bertholf, C. E. Bills, W. L. Dolley, Jr., S. W. Geiser, W. N. Hess, C. L. Prosser, O. S. Reimold and J. P. Visscher.

The University of Kentucky celebrated the seventieth birthday of Professor T. H. Morgan on September 25. Dean Fernandus Payne of the University of Indiana—a former pupil—paid tribute to him at a morning convocation; in the afternoon a bronze plaque marking Dr. Morgan's birthplace was unveiled at Hopemont in Lexington, Kentucky.

On the occasion of its Tercentenary celebration Harvard University conferred doctorates of science upon Dr. Ross G. Harrison as "An embryologist whose method of transplantions yields new insight into the process of development"—and on Dr. John H. Northrup as "A chemist turned biologist, a skilled manipulator of those catalysts on which life depends."

DR. FELIX A. BERNSTEIN took up his work in October as professor of statistics at New York University.

DR. B. J. LUYET of St. Louis University has been advanced from associate professor to professor of biology.

The Waterman Institute of Indiana University has added Dr. W. R. Breneman to its staff as assistant professor. He is devoting his full time to research in endocrinology.

DR. JOHN W. GOWEN, has been appointed professor of genetics at Iowa State College. For a number of years he has been research geneticist for the Rockefeller Institute for Medical Research at Princeton University.

DR. H. J. VAN CLEAVE, professor of zoology, University of Illinois, is chairman of an executive committee in charge of the department in the absence of Dr. Charles Zeleny who is on leave of absence because of illness.

REV. MICHAEL FRONCZAK—who took the embryology course at Woods Hole this summer—has been added to the teaching staff of Seton Hall College where he is in charge of embryology.

DR. F. K. SPARROW, JR. formerly assistant professor of biology at Dartmouth College is now assistant professor of botany at the University of Michigan. During the past summer he studied marine fungi at the Woods Hole Oceanographic Institution.

DR. ELIZABETH ADAMS, who is on leave of absence from the department of zoology at Mount Holyoke College, is visiting the centers of endocrine research in this country. Professor Ellinor H. Behre of the Louisiana State University is carrying on Dr. Adams work at the College while she is away.

PROFESSOR ROBERT A. BUDINGTON, for twenty-three years head of the department of zoology at Oberlin College, has been succeeded in that position by Dr. Charles G. Rogers who is professor of comparative physiology in the department. This change has been made in order to give Dr. Budington more time for his research and teaching program.

PROFESSOR RALPH S. LILLIE of the University of Chicago has been elected a vice-president of the American Association and chairman of the section of zoological sciences. Professor George A. Baitsell of Yale University has been elected secretary of the section.

Rhode Island State College has received a grant from the State government enabling it to establish a marine biological laboratory on the shore of Narragansett Bay in the vicinity of Fort Kearney.

PROFESSOR W. C. ALLEE and SCHMIDT are bringing out a revised American edition of Hesse's "Tiergeographie auf Oekologischer Grundlage."

ENDOCRINOLOGY DURING THE LAST TEN YEARS

Dr. Frederick L. Hisaw
Professor of Zoology, Harvard University

If advancement is measured by the number of new ideas, discoveries and published reports it seems quite probable that no other biological science has equaled the record established by endocrinology for the last ten years. This remarkable advancement was made possible, of course, by previous physiological and clinical work. At the beginning of this period the basic physiology of the thyroid, parathyroids, adrenals, pancreas, pituitary, gonads and a few of the gastro-intestinal hormones was known. The recent advances in thyroid physiology have been the synthesis of thyroxin and the influence of the thyroid on other endocrine reactions. The parathyroid hormone was isolated in 1923 but during the last decade its effects on calcium metabolism have been studied extensively. Epinephrine or adrenalin was synthesized about 25 years ago but the adrenal, cortical hormone, Cortin, the defficiency of which produces Addison's disease, was isolated only recently and is now used extensively in the clinic. Although the relation of the pancreas to carbohydrate metabolism has been known for many years the actual isolation of insulin was not accomplished until 1922. Studies of the physiological action and therapeutic use of this hormone have been greatly advanced during the present decade.

Studies of pituitary physiology, during the period under consideration, have been exceedingly fruitful. In 1926 it was known that extracts of the posterior lobe of the pituitary possessed oxytocic, vasopressor and anti-diuretic properties and were useful clinically while now it is known that the oxytocic and vasopressor actions, at least, are due to two distinct hormones. However, the normal function of the posterior lobe remains a question. Also in 1926 the anterior lobe of the pituitary was known to secrete a hormone which had an effect on body growth and perhaps another which regulated activities of the gonads. Now, in the literature, we find not only the growth hormone and two gonadotropic hormones but others, such as, thyrotropic, diabetogenic, adrenotropic, parathyrotropic, and lactogenic. It is not possible at present to conjecture, with any degree of certainty, as to whether or not all these known effects are due to individually different hormones as very few if any of the preparations thus far prepared are physiologically pure. Yet it is astonishing, to say the least, that so small a gland can be of such importance in so many body functions.

In addition to the gonadotropic hormones of the anterior pituitary other active substances of similar nature have been isolated from the urine of castrated men and women, urine of women past the menopause, urine, blood and placentas of pregnant women and the blood of pregnant mares.

The physiology of the gonads has been advanced remarkably during the last ten years. The oestrogenic hormone, oestrin, from the Graafian follicle was the only one of this group that had been isolated previous to this period. Since then, the progestational hormone of the corpus luteum and the male hormone of the testis were isolated. Also oestrogenic hormones were discovered in the blood, urine and placental tissues. At the present time all these hormones, as well as many related oestrogenic substances, have been crystalized and synthesized.

Endocrinology is relatively young and it is not possible to predict just when it will reach maturity or what position it will be given among the biological sciences. However, the present application of endocrinological ideas and methods to many related fields of research indicates the possibility of a brilliant future. It seems certain that medicine will profit from endocrine research. It is true that endocrine therapy in some respects has not been as successful as hoped for though there are many instances of remarkable results. However, the information at hand has been of great value in making diagnoses and will become more important with new discoveries. Endocrinological techniques and theories are now being applied with advantage to several other allied biological sciences including animal husbandry and veterinary medicine, genetics, experimental embryology, neurophysiology, and abnormal growths.

The present trend of endocrinology, contrary to popular opinion, is not so much one of discovering new hormones but rather that of determining the functions of those already known. Much will be learned, during the next ten years, of the interrelationship of hormonal actions. That is, the observed effects of a given hormone often depend upon the presence or absence of others or whether or not it has been preceded by the action of another, etc. It seems certain that much will be accomplished in this direction regardless of other developments.

DIFFRACTION PATTERNS OF STRIATED MUSCLE AND SARCOMERE BEHAVIOR DURING CONTRACTION

DR. ALEXANDER SANDOW

Instructor in Biology, Washington Square College, New York University

The first observations of diffraction patterns formed by striated muscle were reported by Ranvier in 1874. He placed a flattened frog sartorius in the path of a beam of white light and found that the transmitted light consisted of the directly transmitted beam and also two sets of spectral bands at various angles of diffraction disposed symmetrically on the two sides of the undeviated beam. He correctly attributed this diffraction pattern to the striated structure of the sartorius; the muscle was acting like an optical transmission grating. The angles of diffraction could be accounted for by means of the grating equation: $n\lambda = s \sin \theta_n$ where: n is the order of the spectrum; λ, the wave length of the light at θ_n, the angle of diffraction of the nth order spectrum; and s, the stria distance (i.e. length of sarcomere) of the muscle. Ranvier's experiments with contracting muscle were very limited since he used no objective recording system. He was able to observe directly, however, a momentary divergence of the lateral spectral orders during contraction, from which the conclusion followed that the sarcomeres shorten under contraction.

Although more than sixty years have passed since this original work only three other muscle diffraction publications have appeared. Only one of these, the work of Bernstein in 1895, dealt with contracting muscle. He obtained his records by superimposing on sensitized paper carried on a revolving drum, 5-10 successive photographic exposures to the patterns produced by the contracting muscle. These records clearly show the divergence of the lateral orders and also a general increase in transmission of light by the muscle during contraction. In May of this year, however, Nicolai, working in Germany, and the author reported work with apparatus devised to record on moving photographic film the diffraction patterns along with the myograms produced during single contractions of the frog sartorius.

Nicolai uses the conventional optical system of the grating spectrograph, the muscle taking the place of a transmission grating. This necessitates the use of a 1 cm. broad beam on the muscle. This is ill-adapted to the study of contracting muscle since, if propagated contraction waves are present, the 1 cm. length of muscle forming the diffraction pattern will at each instant include various portions in different phases of contraction.

In the writer's apparatus somewhat unorthodox diffractrometric optics is employed which, however, permits a very intense and narrow beam to be incident on the muscle. This beam at the muscle is 1 mm. wide; hence only about 400 striations form the diffraction pattern and these are practically in the same phase during a contraction. The apparatus is devised so that the beam may be placed at different points along the length of the muscle. Thus through an examination of the patterns formed, this beam is used as a sort of probe for the study of sarcomere behavior within the differently placed 1 mm. segments along the muscle length.

The experiments so far have been made with the frog sartorii held at the *in situ* length and stimulated with supermaximal break inductorium shocks. The *in situ* length was chosen because experiments with resting muscle on the relation between sarcomere length and muscle stretched to various lengths showed that while the sarcomeres are not in parallel alignment at less than *in situ* lengths, they are brought to this condition when the muscle has been stretched to *in situ* (and greater) lengths.

The set of patterns produced by a set of different segments at various levels of the sartorius undergoing isometric twitch include the following: all records have first order spectra of practically unchanged intensity over the whole course of the twitch; the displacements of the first orders produced by the segments of the tibial two-thirds of the muscle indicate (through use of the grating equation) that the corresponding sarcomeres, in relation to their resting lengths, are shortening, whereas the patterns of the pelvic-third segments show that here the sarcomeres are being stretched. The detailed nature of the shortening and stretching of the sarcomeres at the various muscle levels indicates that the muscle wave is initiated at the nerve plexus and then spreads through the muscle away from this region.

During moderately loaded isotonic twitches the patterns show first orders similarly unchanged in intensity, but with very great displacements indicating sarcomere shortening up to 20% of the resting length. Contraction, however, takes place at all levels of the muscle.

During both isometric and isotonic contractions the 0th order increases, and the 2nd order decreases in intensity.

The above results, particularly the intensity variations, are interpreted to mean that Jordan's description of contracting sarcomere behavior

(*Physiol. Rev.*, vol. 13, p. 301, 1933) does not hold for the frog sartorius; but that during contraction of this muscle: (1) a sarcomere, in the sense of consisting of a Q band flanked at each end by one-half of each of the adjoining I (or J) bands remains intact, although (2) it may be stretched as well as contracted depending on its position in the muscle and the nature of the contraction; and (3) there occurs an unequal change in the refractive indices of the Q and I substances, or a variation in the ratio of the lengths of Q and I bands, or both of these modifications. Future research may help define these modifications more exactly.

Preliminary experiments show that the sarcomere behavior during contraction is a function in general of muscle length, tension of lever, position of electrodes and direction of flow of exciting current. It is hoped that investigation of these points will lead to information concerning such features of contraction as internal muscle movements, sarcomere latent period and contraction wave velocity.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 11).

BIOLOGY AT CLARK UNIVERSITY

(Continued from page 259)

of the transmission of nerve impulses across single synaptic junctions and, in addition, in collaboration with Dr. Walter Hunter, he has recently used electrical recording methods in connection with the conditioned reflex technique. He has also turned up some interesting things concerning the factors controlling "spontaneous" discharges of nerve impulses from comparatively simple arthropod ganglia.

Dr. Hoagland's research centers primarily about considerations of the pacemaker control of rhythmic activity in the nervous system. The frequencies of certain electrical brain waves (alpha rhythms) in general paretic patients and in normals has been investigated at the Worcester State Hospital. The evidence indicates that the rhythms are of the nature of "relaxation oscillations" occurring at frequencies proportional to respiratory pacemaker master reactions in the cortical cells. Progression of the spirochete infection appears at intervals of its advancement to shift abruptly the pacemaker (slowest reaction in the chain of respiratory links). This work is being continued during the present year with the assistance of Dr. Morton Rubin.

The question as to why repetitively discharging units such as constantly stimulated sense organs (mechanoreceptors) show a gradual decline in frequency of nerve impulse discharge (sensory adaptation) has also been under investigation at Clark University for some time and constitutes another phase of pacemaker studies. Dr. Hoagland and Dr. Rubin have obtained evidence that mechanoreceptors "adapt" principally owing to the release of potassium under mechanical stress from cells adjacent to the receptor nerve endings. Potassium thus accumulating around a nerve ending, lowers its excitability determining ratio of potassium inside the nerve fiber to that outside to such a degree that the sensory nerve fiber reversibly loses its responsiveness.

During the academic year visitors from outside institutions have been especially generous in coming to Clark University to describe their researches at the afternoon weekly departmental meetings. These discussions have proved most stimulating to staff and students. They often continue deep into the evening under the catalytic facilitation of appropriate beverages.

ITEMS OF INTEREST

Dr. R. P. Bigelow, emeritus professor of zoology, Massachusetts Institute of Technology, is engaged with the surviving author, Dr. H. W. Tyler, in a revision of "A Short History of Science" by Sedgwick and Tyler. He would welcome reprints of any papers dealing with the history of biology or of medicine. His address is: 72 Blake Road, Brookline, Mass.

Professor A. C. Kinsey of the University of Indiana, who took part in the Naturalist's Symposium at Atlantic City is the author of a recently published volume on "The Origin of Higher Categories in Cynips."

Dr. Charles R. Stockard of the Cornell University Medical College presented one of the "Lectures to the Laity" in December for the New York Academy of Sciences. He spoke on the "Mechanisms of Heredity."

Professor A. Franklin Shull of the University of Michigan addressed, in December, the Zoology Club of Northwestern University on "Developmental Genetics in Aphids."

Dr. and Mrs. Sven Hörstadius who spent the past year in research at the Osborn Zoological Laboratory of Yale University and the Marine Biological Laboratory sailed for Stockholm on December 8.

Dr. Walter E. Garrey, son of Professor W. E. Garrey, has completed his five-year internship at Massachusetts General Hospital, having been most recently resident surgeon there. Dr. Garrey has set up his office for general surgery at 279 Clarendon Avenue in Boston and has taken over his duties as assistant surgeon in the department of public health at Harvard University.

DETERMINATION IN THE EARLY DEVELOPMENT OF THE SEA-URCHIN

(Continued from page 243)

rôle of this ion was ascribed to the vegetative part. But if animal halves are treated with lithium, which will cause them to develop like plutei instead of giving only blastulae, then they are susceptible to lack of sulfate.

Mr. Novikoff: Do you think there would be any point in doing experiments such as those with the dead amphibian organizer? Kill the micromeres and coagulate them and put the animal half on top of them, or some such thing?

Dr. Hörstadius: Well, I have tried experiments similar to that—using eggs with a pigmented band. I cut off the most vegetative material of an uncleaved fertilized egg which corresponds to the micromere material and implanted that in an animal half in 64-cell stage. But it would not stay there. The blastomeres bent down, caught this mass and pushed it outside. However, if one takes micromeres, thus intact cells with nuclei inside, this mass remains. The blastomeres are able to distinguish the cells with nuclei from those without! So I became a little more cunning. I waited until the opening of the animal half was nearly closed before I implanted the cytoplasm, and now they remained, but I did not find any action at all. One might try to put down the animal half on some dead cytoplasm, but that is very difficult because the blastulae very soon begin to swim; and we know that the action, both of lithium and micromeres, requires a very long time. It must start pretty soon after fertilization and must go on up to about the gastrula stage if an entodermizing action is to take place.

Dr. Morgan: The lower part of the unfertilized egg is not necessarily of the same material as that which goes into micromeres, because, as the micromeres form at the vegetative pole, a lot of material from the interior of the egg of Arbacia wells up into that region. Which means that material from inside the egg comes to the surface. All I mean by that is to point out that this material which is cut off from the unfertilized egg is not necessarily the same as that which goes into the micromeres.

Dr. Hörstadius: If you cut away this material in the uncleaved egg of Paracentrotus you get exactly the same effect as if you cut away the micromeres later. It may be different in Arbacia.

Dr. Morgan: If you cut away the material of the vegetative half of the unfertilized egg, do you get no micromeres later in Paracentrotus?

Dr. Hörstadius: No micromeres. The region where micromeres can be formed is then missing; and also the skeleton-forming material. They seem to correspond to each other. And this is even before fertilization.

Dr. Chambers: We get some results from cutting Arbacia eggs into very small fragments which would be about the size you mention for the piece you cut off. In about four out of a dozen cases you get micromeres forming from a very small piece which would suggest that their material must have been very close to the cortex. In Arbacia you have no means of orienting the egg. Some fragments have micromeres, others do not.

Dr. Hörstadius: In small fragments like that, if you get small cells, are those cells always comparable to real micromeres, or are they formed because of other factors?

Dr. Chambers: In these small fragments nonpigmented blastomeres appear at about the time the micromeres should form. These tend to be about as large as the other blastomeres and we have identified them as micromeres, simply because they are non-pigmented.

Dr. Willier: How about the differences in the dorso-ventral axis? I am particularly interested in the question of reversal within the dorsal half. What is your explanation of this?

Dr. Hörstadius: Dr. Bernstein has a very interesting explanation to give us.

Dr. Bernstein: I want to give a very tentative explanation of it. Let us first consider what the experiment means if considered in terms of the potentials. If the cut is made (Fig. 5) in the frontal plane, the ventral side, *v*, and the dorsal side, *d*, being separated by the cut, then we have, according to the observation of Hörstadius, the reversal of the gradient in the dorsal half. This

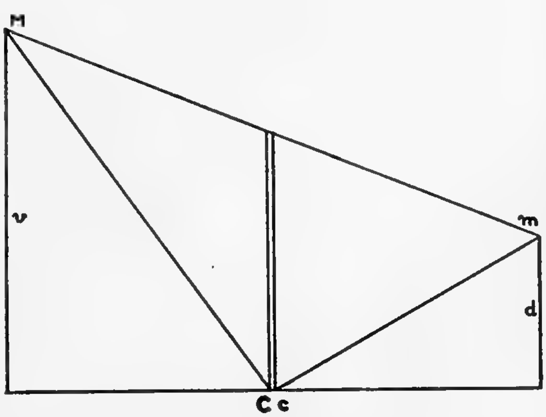

FIGURE 5

means that, instead of the gradient represented by the slope of the line *Mm* falling off from the ventral maximum, *M*, of the potential to the dorsal minimum, *m*, of the potential, we have now two partial gradients: that of the ventral half represented by a line of a slope like that of *MC* and that of the dorsal half represented by a line with a slope like that of *mc*.

That suggests the hypothesis that the gradients with which we are dealing have a material background. We may assume that there exists some substance, *S*, whose concentration decreases from the maximum *M* of the dorsal side to the minimum *m* of the ventral side. By the cut a new surface is formed to which the sea water has access, and the substance still unfixed can be removed and lost into the sea water. As the consequence of the loss, the concentration would become zero at the cut surface in *C* and *c*, and the gradient of the ventral half would be the slope of *MC*, meanwhile the gradient of the dorsal half would be the slope of *mc*. The gradient of the ventral half would become steeper, and in the same sense, meanwhile the gradient of the dorsal half less steep and reversed in sign. Observations of Hörstadius show that after the cut the ventral half develops faster, and the dorsal half develops slower and not so well. This can be attributed to the changes in steepness of the gradients, the loss of the substance *S* also playing some rôle.

Such an assumption can perhaps be tested by using an oiled glass thread for the separation, from which a thin film might spread to cover immediately the newly formed surface so that the communication with the sea water may be shut off. The vital stain in this case of course has to be applied, if possible, not to the cut side, but to the outside. Perhaps no liberation would occur then.

Dr. Hörstadius: We are here dividing the egg in the two-cell stage and then of course no new cell wall is formed, because we cut between cells, but new parts of the cell walls will be exposed to the sea water. We know that there are certain interactions going on between these two cells, but now the inner surface will be in contact with the sea water instead of the other cell; then an exchange with the sea water, instead of with the fellow blastomere, is possible. I think it is a very good idea. The explanation we had before was the following: I said that there are some indications that there exist on the dorsal and ventral sides two fields. It has been found by Foerster and Orström that if you treat an uncleaved egg with KCN you get two depressions, one larger one and one smaller one. If you stain them vitally, the larger one always becomes the ventral side. This may indicate that we have a sort of gradient like Dr. Bernstein's. The explanation we gave is that, after the cut, perhaps the new ventral side of the dorsal half has the same properties in relation to the cut side as the presumptive ventral had before to the presumptive dorsal side. This explanation that something may come out into the sea water which leads to a physical loss would account for the phenomenon we observe.

Dr. Schotté: Couldn't this theory of Dr. Bernstein's be verified by separating blastomeres and after a short while putting them together again?

Dr. Hörstadius: The halves first show open half-blastulae, but they soon close again. After some hours they form a small closed blastula.

Dr. Schotté: I didn't mean hours; I meant minutes.

Dr. Hörstadius: I don't believe that would be enough. I have isolated dorsal and ventral halves from the beginning of development up to the beginning of the gastrula stage, every second hour, and it is not until 10-12 hours after fertilization that you will no longer find reversal of the dorsoventral axis in the dorsal half.

Dr. Harvey: How do you get your cells to stick together when you take out micromeres and implant them?

Dr. Hörstadius: If your eggs have been in calcium-free sea water and are brought back into normal medium they stick. They don't stick if you put them on the outside. You have to make a small opening between some cells and put the implant in between them.

Dr. Lillie: Have you any clear conception of just what the gradient is in the physiological sense? Is it a diffusion field? or some kind of structural field? or an electrical field, in the sense of potential gradient?

Dr. Hörstadius: I cannot come to any conclusion concerning it with this kind of work.

Dr. Lillie: When you say "weakening a gradient," what do you mean experimentally?

Dr. Hörstadius: I just judge from the result: which and how much of the animal and vegetative organs are formed.

Dr. Lillie: Without forming any conception as to the physiological nature of the gradient?

Dr. Hörstadius: No, I cannot do that, no further than those things I read you before.

Dr. Whitaker: Do you think there is any possibility that vital stains, when applied to one side in a certain critical concentration, might in any way effect the dorsal determination?

Dr. Hörstadius: Yes, that has been shown by Lindahl. He sucks an egg into a pipette so that it will be elongated. Boveri showed that if you stretch an egg the median plane of the egg will follow this stretched axis. And Lindahl finds the same. He stained the free end and then pushed

the egg out again. He found that it was always the free end that became the ventral side. He concludes from that there must be some streaming of the protoplasm when the egg is pushed in and, by means of the course of this, we get a different character in the ends. Probably there are different conditions of metabolism at the two poles. If now the free end is stained very strongly so as to hurt the egg, this will be the dorsal side.

Dr. Whitaker: Heavy staining tends to develop the dorsal side?

Dr. Hörstadius: Or rather inhibits the ventral.

Dr. Whitaker: And is it just possible since you do stain that region in order to later identify it, that the stain may have played some part in the reversal?

Dr. Hörstadius: No, because we have tried staining both sides. I foresaw that and so in some experiments we stained the outside of the half blastula instead of the inside and got the same result.

Dr. Whitaker: One question about the energy relations that you referred to—from Tyler's work, which showed that smaller fragments require more energy to attain a given stage of development and tend to develop more slowly; nevertheless you showed that you could isolate small meridional fragments and some will be retarded more than others. I was wondering if it might be that, in different parts of the embryo, the available energy differs, so that, for that reason, two equal sized fragments can be retarded to different extents. It would mean that the additional delay which you ascribe to reorganization changes might really be the result of less available energy in that region.

Dr. Hörstadius: Do you mean that on the ventral side you ought to have more energy than on the dorsal side?

Dr. Whitaker: Yes, I mean that the retardation might be due to the fact that there is less energy available on the dorsal side.

Dr. Hörstadius: I think that is very hard to get at. Isn't it very probable that the formation of the ventral side on the wrong side is a regulation which requires time? I think that both Tyler's idea and the old one of time required for regulation may be true. There may be first a delay which is due to energy lack and another which may be due to regulation.

Dr. Whitaker: That is partly what I am getting at. I wonder if the two things might not be the same in this sense: you say that it requires time for regulation, but doesn't that mean that you have to wait for something to happen which perhaps requires energy?

Dr. Hörstadius: For something to happen, for something that is not in the egg before—or in that part of the egg—I think it very likely that that should take time. Very possibly it may be as you say, but it is hard to reach a conclusion.

Dr. Grave: What do you think of the mosaic theory of development? To what extent was that theory right, and what is its relation to regulation?

Dr. Hörstadius: The difference between the mosaic and the regulative type of development is nowadays considered to be only a gradual one, depending upon the stage of the development at which determination is completed. For example, the uncleaved egg of the nemertine Cerebratulus can produce a perfect larva both from the animal and the vegetative half, whereas in the 8- and 16-cell stage we find the mosaic type: isolated animal and vegetative parts differentiate just into what they would have given in the normal larva. In the uncleaved sea-urchin egg we already have the segregation of different potencies along the egg-axis, so that the animal half cannot give an archenteron. In the cleavage stages we do not, as in Cerebratulus, find a mosaic of fully determined anlagen for organs, but a mosaic, so to say, of different potencies, different activities, which will form the organs after first interacting between themselves. Thus the uncleaved Cerebratulus egg is less than the sea-urchin egg a mosaic, but in the 8 or 16-cell stage it is a more strictly determined mosaic. In other "mosaic" eggs, such as those of ctenophores, annelids, mollusks, etc., the determination seems to occur still earlier.

Dr. J. Holtfreter, who left Woods Hole shortly before the discussion took place, has in a letter sent the following contribution: In the sea-urchins, the determination of the animal half depends upon the vegetative, that is to say, early isolated presumptive ectoderm reacts in another way to later implanted micromeres than does presumptive ectoderm which has all the time remained in contact with the vegetative part. This is not so in the amphibians. Here the course of determination in the ectoderm is independent of the other part of the embryo: early isolated ectoderm loses the capacity to react to implanted inducers at the same time as the ectoderm in the embryo. This seems to have to do with the fact that the sea-urchin egg probably is a less stable system than the amphibian egg—compare all the differences in differentiation that you can obtain in the sea-urchin egg by the removal and adding of animal and vegetative material. In the amphibians the inducers act chiefly by contact, when underlying the ectoderm. In the sea-urchin perhaps we have to do with a lateral diffusion.

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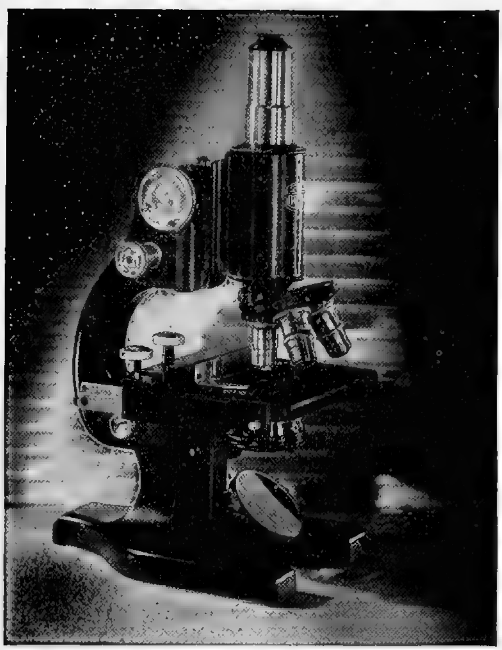

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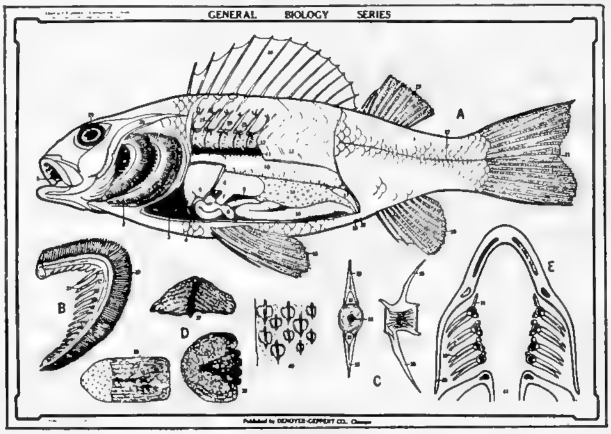

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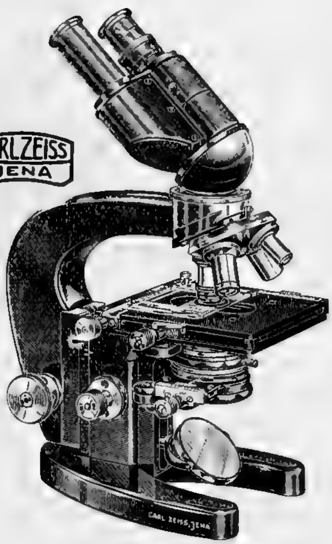

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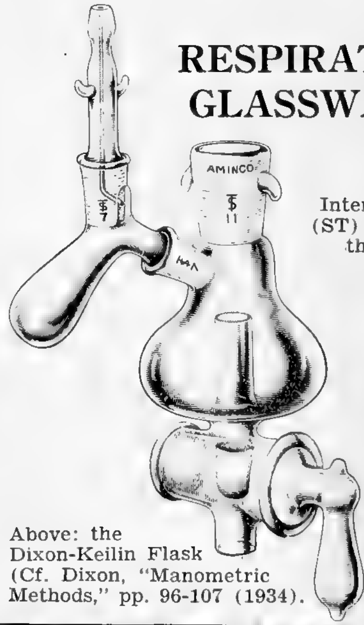

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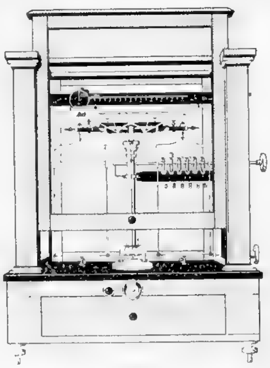

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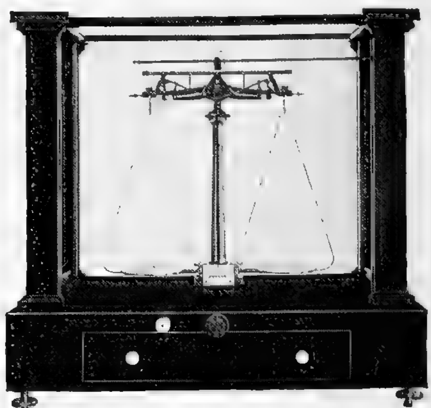

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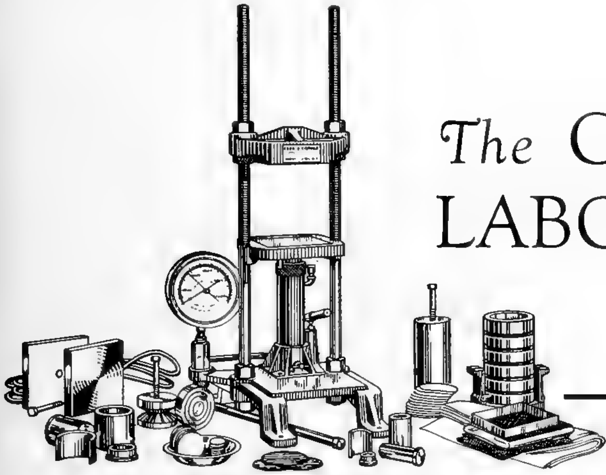

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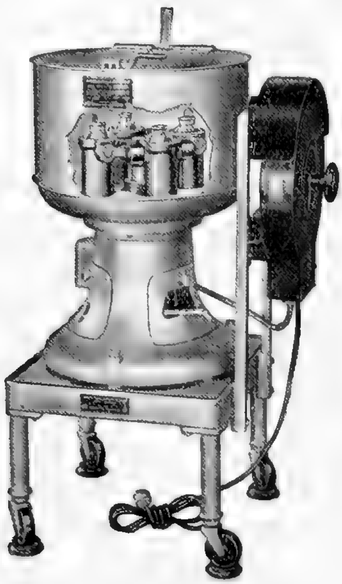

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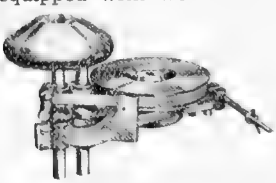

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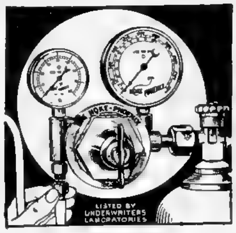

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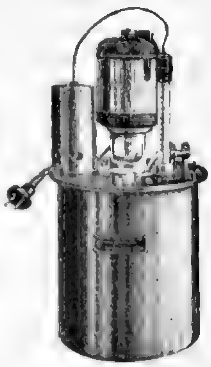

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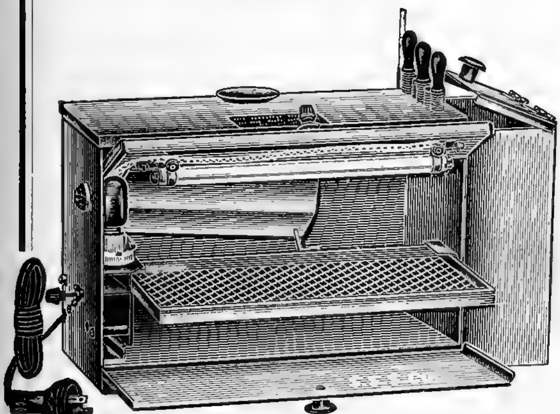

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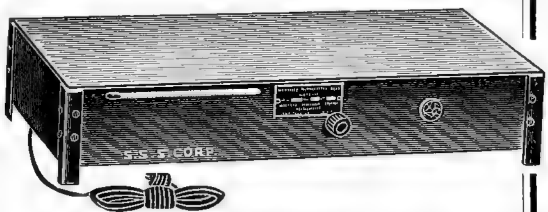

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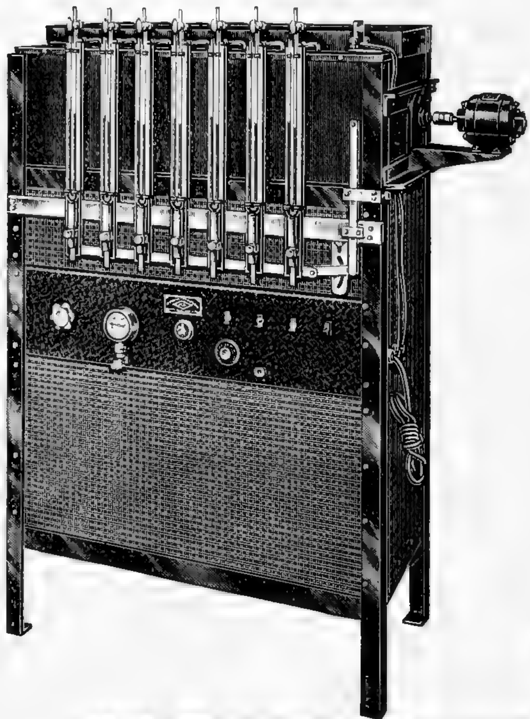

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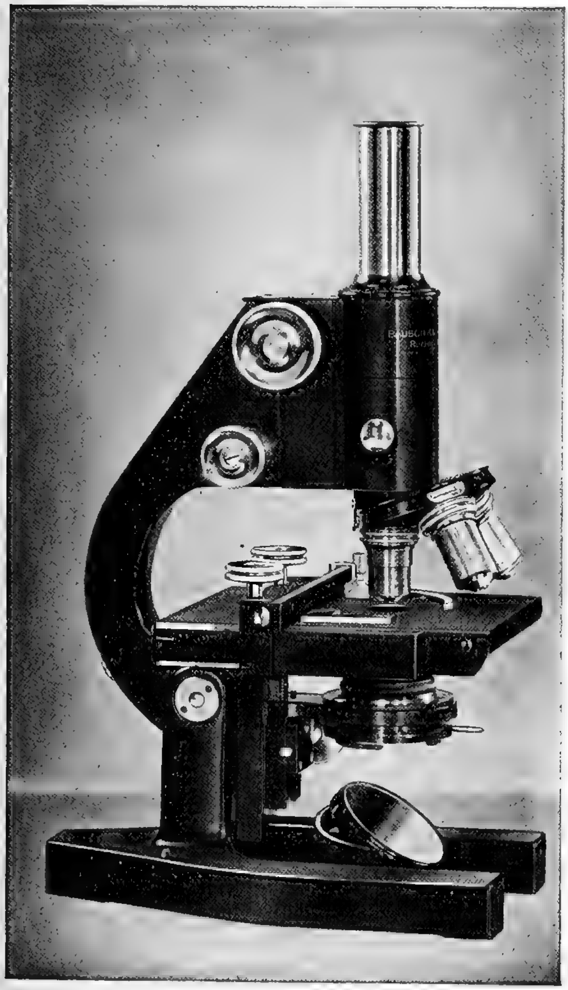

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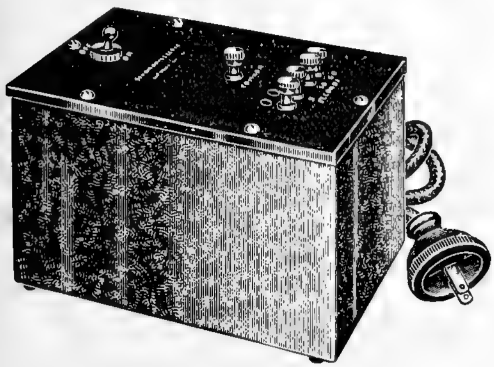

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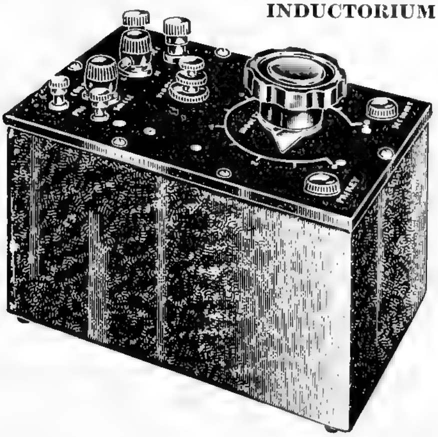

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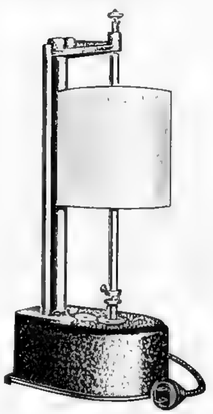

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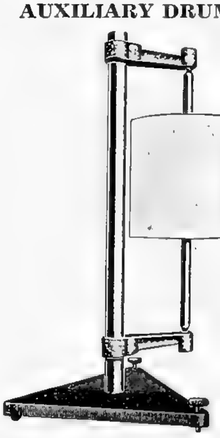

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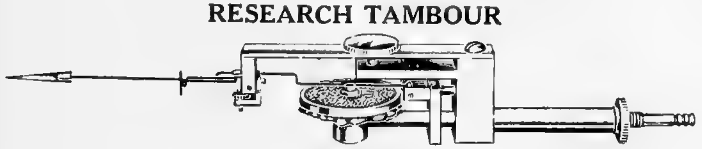

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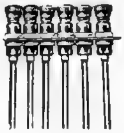

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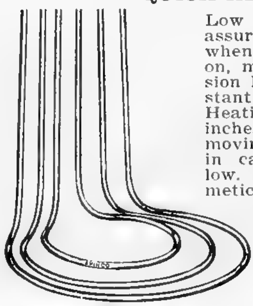

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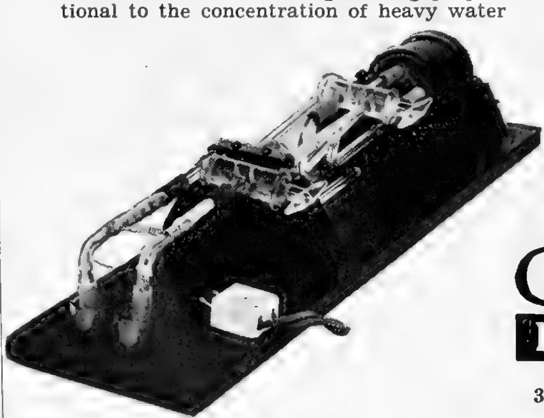
IN THIS instrument for analysing heavy water, use is made of the difference in thermal conductivity of hydrogen and deuterium. The hydrogen deuterium mixture is produced by electrolysis of the heavy and ordinary water mixture; the concentration of deuterium in the gas being proportional to the concentration of heavy water in the liquid. Two small electrolytic cells, each holding about 1 cc. of liquid are arranged so that the gas from the negative electrode of each cell passes through one of the two chambers of a differential thermal conductivity meter. If one chamber contains hydrogen and the other a hydrogen deuterium mixture, the bridge will not be in balance, the out-of-balance current being a measure of the concentration of the deuterium in the mixture. This concentration is proportional to the concentration of heavy water, which may be either indicated or recorded.



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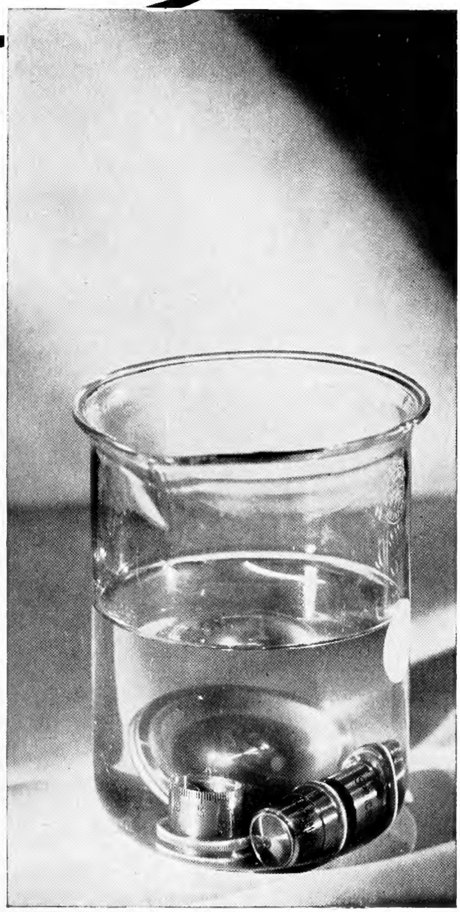

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